Demonstrating Cleaner Vehicles

Guidelines for Success

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What are these Guidelines for?

A reference guide to good practice

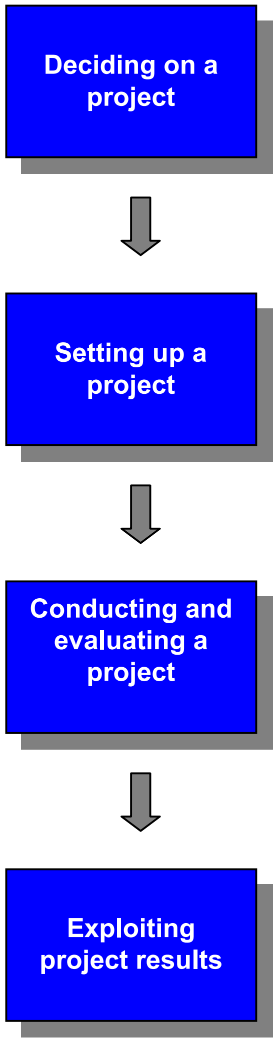
These Guidelines provide advice on how to set up and run pilot and demonstration projects with cleaner vehicles. The aim is to promote good practice that minimises the risk of wasted investment.

The document focuses on urban applications of two-wheelers, cars, buses, vans and trucks. The intended users are people who promote, fund or implement local projects, including:

- project champions, project managers and their teams of experts;
- local authorities, fleet operators and other sponsors of pilot and demonstration projects.

The Guidelines cover the decision points and evaluation phases through the entire lifecycle of a demonstration project. They start with the process of deciding on a project. Next they address the design stage and prior assessment. Then comes implementation and evaluation. Finally, the Guidelines advise on questions of follow-up and exploitation of the results.

Guidance is given on what to do and consider at each lifecycle stage. This is supported by examples and good practice recommendations derived from a wide variety of European project experiences.



Getting started

This document has two main parts. The Overview explains how to use the Guidelines, summarises the key actions at each lifecycle stage, and highlights some important success factors. The Sections then elaborate the lifecycle stages in detail, illustrated by case studies.

Readers are recommended to start with the Overview, and consult the Sections where they have a special interest.

…..and why are the Guidelines needed?

A number of weaknesses have been identified in previous demonstrations of cleaner vehicles, notably the following:

Ambiguous objectives lead to uncertain results.

- *Objectives* that are ambiguous, difficult to evaluate, not supported by important stakeholders and inadequately linked to the underlying problems.
- *Problems with vehicles*, especially where the performance in real life has been lower than promised. Examples include poor reliability, reduced range and high fuel consumption. Late delivery has been a common experience, and also slow or inadequate technical backup.
- *Premature emphasis on commercial viability*, before the application of the new technology has matured and user acceptance has been developed.

Over-optimistic publicity can lead to a negative impression.

- *Premature publicity*. An over-ambitious opening ceremony or over-optimistic launch publicity, before the technology has been proved in operation, can lead to trouble if technical difficulties become apparent. The media will focus on unlucky happenings, and it is difficult to get rid of a negative first impression.
- *Failure to measure critical indicators*. The evaluation must focus on the project objectives. For example, if a project aims to achieve modal shift, then adequate resources must be put into traffic counts and user surveys to *prove* the extent of modal shift.

Risk management is essential for making innovations work.

- *Lack of risk analysis and contingency planning*.
- *Departure of the project champion*, and a failure by stakeholders to identify a suitable replacement or redistribute responsibilities.
- *Inadequate project duration*. Optimal vehicle performance and patterns of operation may take 1–2 years to develop. Users and policy-makers may require even more time to change their attitudes and behaviour.
- *Lack of awareness among the public and policy-makers* about local transport problems and the potential benefits of new solutions, leading to a lack of consensus behind the project to drive it forwards.
- *Unrealistic expectations of the interest and ability of vehicle manufacturers and suppliers* to provide and support new propulsion technologies, particularly for small projects.
- *Lack of municipal power to introduce supporting policy measures*.
- *Disagreement among stakeholders*. A formal collaboration agreement may be needed, defining responsibilities.

Plan the exploitation strategy from the outset.

- *A failure to plan the exploitation strategy and follow-on at an early stage.*

These problems can be avoided or mitigated by good planning and management. Using the Guidelines will help to achieve this.

Contents

Preface

These Guidelines have been developed in the UTOPIA project, co-funded by DG Transport and Energy of the European Commission. Additional market feedback was obtained in the ENIGMATIC project, also funded by DG Transport and Energy. The Guidelines do not represent the official viewpoint of the European Commission.

The Guidelines are intended to provide a practical tool to enhance the prospects of success for pilot and demonstration projects with new propulsion systems. Such projects are seen as a key strategy in promoting the market introduction of transport solutions based on cleaner vehicles.

The Guidelines are intended to complement the more generic MAESTRO Guidelines (funded by DG Transport and Energy) that cover pilot and demonstration projects of all types throughout the transport sector.

Further information on UTOPIA and the projects featured in this document can be found on the Web-sites listed in the References section.

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UTOPIA project partners

EST	Energy Saving Trust (co-ordinator)	UK
ADEME	French National Energy Agency	FR
AEAT	AEA Technology plc	UK
AMOR	Austrian Mobility Research	AT
AVERE	European Electric Road Vehicle Association	BE
BTSA	Barcelona Tecnologia SA	ES
CERTU	Technical Department of French Ministry of Public Works	FR
CETE Lyon	Technical Department of French Ministry of Public Works	FR
CETE Nord-Picardie	Technical Department of French Ministry of Public Works	FR
CGFTE	Praxitèle project, St Quentin-en-Yvelines	FR
CityCar	CityCar project, Martigny	CH
CSST	Centre for Transport System Studies	IT
DITS	University of Rome La Sapienza, Department of Transport	IT
DM	Design Management AS	NO
ENGVA	European Natural Gas Vehicle Association	NL
IER	University of Stuttgart, Institute of Energy Research	DE
InfoVEL	Mendrisio electric vehicle fleet test	CH
INSEAD	European Institute of Business Administration	FR
Intelmark	Intelmark	FR
JRC	EC Joint Research Centre	BE
KFB	Swedish Transport and Communications Research Board	SE
TNO	Netherlands Organisation for Applied Scientific Research	NL
UTwente	University of Twente, Department of Philosophy of Science and Technology	NL
VTT	Technical Research Centre of Finland	FI
VW	Volkswagen AG	DE

Abbreviations, acronyms and symbols

The following abbreviations and acronyms are used in the text.

CBA	cost-benefit analysis
CEA	cost-effectiveness analysis
CNG	compressed natural gas
CO	carbon monoxide
CO_2	carbon dioxide
DME	di-methyl ether
EC	European Commission
EU	European Union
EV	electric vehicle
FAEE	fatty acid ethyl ester
FAME	fatty acid methyl ester
GAM	goal achievement matrix
HC	hydrocarbons
ICE	internal combustion engine
ISO	International Standards Organisation
kph	kilometres per hour
LNG	liquefied natural gas
LPG	liquefied petroleum gas
MCA	multi-criteria analysis
NO_x	nitric oxides
PM	particulate matter
SO_2	sulphur dioxide

Overview

In these Guidelines, a "project" is a pilot or demonstration project with cleaner road vehicles.

What do the Guidelines cover?

What is the purpose of the Guidelines?

The Guidelines provide advice on how to set up and run pilot and demonstration projects with cleaner vehicles in cities. The goal is to help decision-makers and project teams design and run projects in the most efficient and effective way possible, avoiding likely problems and managing potential risks.

When should the Guidelines be used?

The Guidelines support the various stages of decision making over the lifecycle of a project, from proposing an initiative through to evaluating the results and the options for follow-up work.

Consult the Guidelines when each new stage of the project lifecycle is to be tackled.

They are designed to be used as a reference manual or "recipe book", for consultation when each new stage of the lifecycle is to be tackled. As such, they provide a *coherent* but stylised set of good practice steps. Inevitably though, for hands-on application, the steps have to be tailored to every situation – the Guidelines are not a prescriptive model to be followed precisely. Therefore each reader must select the relevant elements in the most appropriate order.

Who should use the Guidelines?

The Guidelines are aimed primarily at people who develop local pilot and demonstration projects. These include:

- project champions who initiate and facilitate such schemes;
- the project managers and experts who design, run and monitor the project implementation;
- host organisations, partners and sponsors, such as fleet operators and transport authorities.

Annex 1 lists typical applications covered by the Guidelines. The project in question can be a pilot project for a larger-scale demonstration or commercial application of an innovative transport technology or service. Alternatively it may be a demonstration project aimed at market testing or learning about user responses.

Why are the Guidelines needed?

The Guidelines are needed to get a better take-up of good practice in demonstration projects with cleaner vehicles. This will improve cost-effectiveness in the use of public funds, and increase the prospects for successful market introduction of such vehicles. It will also help future projects to avoid common problems encountered previously, such as:

- a failure to measure key indicators that would show whether or not the project's objectives have been reached;

- a lack of consistency between evaluation strategies in different cities, limiting the scope for cross-city learning within a national or European programme;
- resistance from local stakeholders who have not been involved at the planning stage.

Comprehensive guidance has not previously been compiled on the practical issues facing vehicle projects throughout the lifecycle stages. In addition, over the last few years, significant new experiences have been gained through large-scale multi-city demonstration projects at national and European levels. The focus has moved away from pilot testing of vehicle technologies, towards demonstration projects aimed at opening up the market for clean vehicles and embedding new technologies within the urban transport system.

Therefore this document pulls together good practice recommendations and examples of learning from recent projects across Europe. Also, since many projects draw on funding from national and European programmes, the Guidelines highlight ways of meeting the expectations and objectives of the different funding levels.

The Guidelines are based on a wide variety of European project experiences.

How do these Guidelines relate to existing standards and codes of practice?

A number of standards exist for quality assurance, project management and environmental management that may affect a pilot or demonstration project. The most commonly observed is ISO9000, used by many organisations to define basic procedures to ensure that work is done according to plan or design. The Guidelines are designed to be consistent with existing standards, and draw attention to key aspects of risk management where appropriate.

The Guidelines are complementary to *generic* standards and good practice for project management.

The external standards provide the *generic* context and process for conducting a project, while the Guidelines provide particular detail of topics to consider and possible actions. For example, the Guidelines highlight the need to design the evaluation process in such a way that the potential for scaling up the project, or transferring its results to another context, can be assessed at the end. ISO9000 specifies how such calculations should be recorded and checked.

Does good practice for the management of pilot and demonstration projects differ from that for other projects?

From industry experience and those involved in project management, the consensus is ‘No’. Most guidance on project management splits a project’s lifecycle into stages, one of which is the pilot or demonstration phase. The same principles of project management apply throughout the project lifecycle.

How should the Guidelines be used?

How are the Guidelines structured?

Four main life-cycle stages:
- decide on a project;
- set it up;
- conduct and evaluate the work;
- decide on exploitation.

The Guidelines are split into main Sections according to broad lifecycle stages: deciding on a project, setting it up, conducting and evaluating the work, and making decisions on the exploitation of the results. Each stage includes an element of evaluation.

Within each Section, the important topics are identified and guidance provided on how to tackle them. Examples are given of how certain issues have been handled in the past and how they can be critical to the success of the project. These examples draw on recent projects across the European Union.

Procedures for project design, site selection and project evaluation are considered in detail in Section 3 (Setting up a project). These topics are also relevant to the decision on the project and the assessment of the results, so cross-reference is made to Section 3 where appropriate, rather than duplicating text unnecessarily in other Sections.

How adaptable are the Guidelines?

The Guidelines present the lifecycle stages in a linear form for ease of finding information.

We do not expect *real-life* projects to follow this linear model of the process. Rather, there will be overlap and iteration between the various stages, and some of the steps may need to be merged or taken in a different order. It is essential to treat these Guidelines as advisory and not prescriptive.

For example, project learning and planning for exploitation will generally start during the technical implementation, and not just at the end when the final results are available.

We also recognise that projects arise in a variety of ways. Some are driven top-down by policy needs. However, many arise in a bottom-up way, where an entrepreneur spots an opportunity to use a new technology in a particular place. The Guidelines aim to accommodate this variety, but cannot hope to provide a step-by-step action list for every situation.

Even for projects that are not driven by policy, a mapping onto policy objectives can help public relations.

For completeness, we have chosen to base the Guidelines on the full sequence of steps for identifying projects from transport problems and policy objectives. Some of these initial steps may appear superfluous to a bottom-up project, which usually starts with the definition of project objectives. Nevertheless, it is often advisable for such projects to map back onto local transport issues in order to justify the innovations to users, sponsors and regulatory authorities.

So the reader is invited to use the summary of good practice at the end of this Overview to identify those elements of the Guidelines that seem relevant to their situation. Subsequently, the reader may wish to consult the main Sections of the Guidelines for further detail at each lifecycle stage, as listed in Table 1a. As a guide, Table 1b summarises key actions through the project life cycle.

Table 1a. Lifecycle stages of a demonstration project

Lifecycle stage	Steps involved	Relevant Sections of the Guidelines
Decide on a project	Involve stakeholders	2.1
	Define the problems to be addressed	2.2 Step 1
	Assess alternative transport solutions	2.2 Step 2
	Identify whether a pilot or demonstration project is needed	2.2 Step 3
	Define the project objectives	2.2 Step 4
	Assess the project options	2.2 Step 5
	Define the preliminary design and assess user needs	2.2 Step 6
	Make an initial evaluation of the proposed project	2.2 Step 7
	Refine the proposal	2.2 Step 8
	Make a go/no-go decision	2.2 Step 9
Set up the project	Define and assess the detailed design	3.1
	Select/confirm the site	3.2
	Design the data collection and evaluation	3.3
Conduct and evaluate the project	Manage the project	4.1
	Measure and evaluate the results	4.2
Exploit the project results	Learn from the project	5.1
	Identify implications for other cities	5.2

Table 1a identifies where to find further information in these Guidelines.

See pages marked with a red box in the top corner.

See pages marked with a yellow box in the top corner.

See pages marked with a green box in the top corner.

See pages marked with a blue box in the top corner.

Table 1b summarises key actions through the project life cycle.

Table 1b. Lifecycle stages of a demonstration project

Lifecycle stage	Management actions	Technical operations	Project evaluation	Exploitation actions
Define problems	Involve stakeholders			
Assess transport solutions	Involve stakeholders			Assess full-scale solutions
Choose to pilot	Assess value of pilot-scale application			Select a promising solution
Define project objectives	Secure stakeholder commitment		Identify critical results to be proven	Define exploitation strategy
Assess project options	Initial risk assessment		Select appropriate technologies	
Define preliminary design	Relate to user needs		Define evaluation strategy	
Initial evaluation	Detailed risk assessment		Review design, evaluation plan and likely outcome	Review exploitation strategy
Refine proposal	Review objectives			
Go/no-go decision	*Funding adequate?*	*Viable project?*	*Credible expectations?*	*Credible exploitation?*
Define/assess project design	Involve stakeholders and project team, assess risks	Make contingency plans, collect baseline data	Evaluate detailed design and baseline results	Develop exploitation plans and marketing strategy
Select/confirm site	Relate to aims of sponsors			
Design data collection and evaluation	Identify critical indicators		Design data collection and evaluation plan	Confirm critical indicators
Manage the project	Monitor and communicate	Implement and fine-tune		Control dissemination
Measure and evaluate	Assess uncertainties	Collect results' data	Evaluate continuously	Continuously feed into exploitation
Draw lessons	Involve stakeholders	Conduct post-project review	Identify key results *and* broader learning	Assess risks of full-scale exploitation
Transfer results	Disseminate findings		Identify site-independent aspects	Control dissemination

Summary of good practice

What are the key actions at each stage of the project lifecycle?

This Summary brings together the good practice recommendations highlighted in Sections 2 to 5 of these Guidelines, to allow easy use as a checklist by the reader.

Deciding on a project

See Section 2.1.

Involve stakeholders

- Involve stakeholders in the project from the very beginning.
- Invite a range of stakeholders to take part, whether as project partners or in a more advisory role.
- Approach stakeholders individually, starting with the one that would impact the most on getting others to join.
- Establish a formal collaboration agreement, defining stakeholder responsibilities.
- Set up a forum where stakeholders can discuss their ambitions and roles.
- Have a continuing dialogue to review objectives, progress, results and exploitation strategy.
- Aim to secure financial and other resource inputs from stakeholders that will encourage them into an active participation.
- Where national or European funding is requested, identify how the local project must reflect higher-level policy objectives and evaluation requirements.
- Involve stakeholders in project publicity, but avoid premature and over-optimistic launch publicity.
- Disseminate project news to politicians and the public.

See Section 2.2 Step 1.

Define the problems to be addressed

- Put down on paper a first statement of the obvious local concerns to be addressed.
- Think more widely about the policy context and the objectives of potential funding programmes.
- Consider the perspectives of the range of potential stakeholders and transport users.
- Draft a problem definition and obtain stakeholder feedback.
- Develop an agreed statement of the problems and their relative importance (before starting to define solutions).

See Section 2.2 Step 2.

Identify alternative transport solutions

- Identify viable alternative strategies that address the problems of concern.
- Collect information on the various alternatives from a variety of sources (experts, Internet, experiences elsewhere).
- Estimate the relative cost-effectiveness of alternative strategies in tackling the specific problems within the local city context. This may include modelling the effects on emissions and air quality.
- Relate the strategies to the needs of the transport users.
- Assess ways of funding the various alternatives.

- Make an inventory of the barriers to realisation of the various strategies, including social, technical and economic barriers.
- Identify influencing factors such as acceptance by the various stakeholder groups (fleet operators, other road users, general public, shopkeepers, policy-makers etc.).
- Assess whether a transport solution involving cleaner or alternative-fuelled vehicles has the potential to make a significant contribution in overcoming the stated problems.
- Record the main uncertainties concerning the performance of the cleaner vehicle option(s) and any associated policy measures.
- For the cleaner vehicle option(s), identify the route to achieve a sustainable outcome (e.g. as part of a commercially viable transport service) within an acceptable time frame.
- Discuss the various options and major dilemmas with relevant stakeholders.
- Choose the option(s) to pursue, for example using a multi-criteria analysis.

From this stage onwards, the Guidelines assume that a solution involving cleaner vehicles has been selected.

Identify whether a pilot or demonstration project is needed

See Section 2.2 Step 3.

- Assess whether the chosen solution could be sustainable in the longer-term (e.g. in the absence of temporary Government grants and tax subsidies).
- Assess whether the chosen solution is likely to be the most cost-effective option in delivering the targeted benefits such as emissions reductions.
- Assess whether uncertainty over the implications of full-scale implementation necessitates carrying out a small-scale trial.
- Determine how a pilot project would lead to further implementation opportunities.

A project that results from someone spotting an opportunity to use a new technology in a particular place may start at the next step. However, identifying the problem definition and policy drivers retrospectively can help to justify the project and any public funding.

See Section 2.2 Step 4.

Define the project objectives

- Define and disseminate a statement of objectives that (a) is short and easy for everyone to understand, and (b) specifically addresses the problems to be tackled.
- Involve stakeholders (including end users) in setting objectives.
- Relate the objectives to the exploitation strategy for implementation opportunities after the pilot phase.
- Ensure that the objectives are suitable for direct investigation and evaluation, if necessary by modifying or dropping objectives.
- Review and be prepared to modify objectives during the course of the project.

See Section 2.2 Step 5.

Assess the project options

- Review the alternative vehicle technologies and related transport concepts, and see which provide the best match with the project objectives.
- Assess the local conditions that may require specific actions to be taken, such as the introduction of new policy measures.
- Talk to the funding agencies.
- Make a first assessment of risks inherent in the project.
- Check that the scale and scope of the project should be sufficient to allow key outcomes such as modal shift to be measured.

See Section 2.2 Step 6.

Define the preliminary design and assess user needs

- Systematically cover all the design aspects needed for the functional specification of the project.
- Discuss this preliminary design with the stakeholders and funding agencies.
- Assess user needs for the transport solution and user acceptance of changes in behaviour. Distinguish various types of user, including leading edge versus average users where appropriate. Determine whether leading edge users should be targeted.
- Be clear to what extent user needs should shape the project or to what extent the objective is to change and measure user behaviour. Set up channels for ongoing user feedback to the project.

See Section 2.2 Step 7.

Make an initial evaluation of the proposed project

- Estimate whether the design and the planned measurements will allow the project to demonstrate unambiguously whether or not the objectives have been reached.
- Check whether the strategy for exploiting the project results looks realistic.
- Systematically assess the project feasibility and all the risk factors, including its environmental acceptability.

Refine the proposal

See Section 2.2 Step 8.

- Assess potential discrepancies between the project design, the project objectives and the user needs.
- If needed, adjust the objectives and/or design and repeat the evaluation.

Make a go/no-go decision

See Section 2.2 Step 9.

- Check the proposal against the main decision criteria at the local level.
- Assess the proposal against the decision criteria that will be applied by funding agencies, such as national and European programmes.

Setting up the project

See Section 3.1.

Define and assess the detailed design

- Define the financial, legal, political and time constraints at the start of the design process.
- Ensure that the design covers *all* the technical and non-technical aspects of the project that need planning.
- Check that the design (including the data collection plan) is able to achieve the project objectives.
- Check that the design satisfies the requirements of stakeholders and end-users.
- Allow at least one year for testing vehicle technologies, and allow at least two years to demonstrate new mobility solutions that require a change in user behaviour.
- Allow plenty of time for training and adapting to new vehicles.
- Allow adequate time and budget for post-project review and final reporting.
- Where inter-site comparison is intended, avoid too many differences between sites.
- Consider co-ordinated procurement of vehicles, combining orders across several projects/cities, particularly for less-developed technologies.
- Develop a marketing strategy, aimed at all stakeholder groups including end-users and vehicle operators.
- Analyse risks and develop a risk management plan, particularly for common problems such as late delivery of vehicles.
- Assess the detailed design, estimate the expected impacts of the project and take an explicit go/no-go decision.

See Section 3.2.

Select/confirm the site

- Define criteria that will test the ability of the site to meet project objectives and the interests of stakeholders.
- Include feasibility criteria based on the project risk analysis.
- Check the site proposal against criteria defined by national and European funding agencies, where appropriate.
- Minimise bias in the site selection procedure by making the procedure open and objective.

Design the data collection and evaluation

See Section 3.3.

- Develop the evaluation strategy as an integral part of the project design from the start.
- Check that the evaluation will deliver the *essential* measurements and indicators to prove whether or not the project objectives have been achieved, particularly where budget constraints on the evaluation effort are tight.
- Check what data collection will be needed at the start of the project *before* the new transport solution is piloted.
- Check what is needed to facilitate cross-city comparison (especially where this is a requirement of funding agencies).
- Define an adequate range of impacts and indicators to address the range of stakeholder interests.
- Within cost limits, collect experiences from those involved in the project, as well as measuring quantitative indicators. Review the data while the project is running.
- Note the collected good practice for vehicle energy and emissions measurements given earlier in these Guidelines.
- Use multi-criteria analysis for the overall project evaluation with stakeholder participation. Supplement this with cost-benefit analysis for economic evaluation and cost-effectiveness analysis for screening options for the project design.

Conducting and evaluating a project

See Section 4.1.

Manage the project

- Define specific milestones for progress monitoring.
- Keep the management structure simple and light, with well-defined responsibilities, so that the managers can adapt quickly to unforeseen situations.
- Evaluate the results progressively as the project develops, so that decisions on follow-on actions can be taken during the course of the project.
- Monitor and solve technical problems efficiently, especially in the early stages of project implementation.
- Create a strategy for managing the information gathered in the project, to allow easy exchange within the project team but controlled release of overall project findings to a wider audience.
- Communicate and disseminate information according to a defined marketing strategy.

See Section 4.2.

Measure and evaluate the results

- Be prepared to change the data collection procedures during the project.
- Always focus on matching the evaluation outputs to the project objectives, and identify the benefits per stakeholder group where possible.
- Ensure that the same impacts are determined using consistent methods at different test sites.
- Record the factors specific to the city and the operating context that have an influence on the results.
- Compare ex-post results with equivalent ex-ante estimates, and investigate the reasons for significant differences.
- Identify the differences in outcomes “with” and “without” the project.
- Identify and assess the uncertainty present in the measured results from the project.
- Develop interim/preliminary results that are useful for decision-making on exploitation and follow-on.
- Identify and assess the risk and uncertainty associated with the transfer of conclusions into recommendations regarding the wider application of the transport solution following the project.

Exploiting project results

Learn from the project

See Section 5.1.

- The project team and stakeholders should conduct a post-project review.
- The outcome of the review should include a clear statement of the risk and uncertainty present in the results and conclusions from the project.
- The review should aim to cover broader areas of learning as well as evaluating the success of the project in attaining specific objectives. For example, changes in stakeholder expectations of the demonstrated technology/solution should be explored.

Identify implications for other cities

See Section 5.2.

- Produce transferable information by documenting the details of the project implementation and the city context as well as the actual results.
- Prepare a report that is explicitly targeted on wider dissemination, in consultation with stakeholders.
- Highlight the learning on issues of wider interest, such as barriers to new transport solutions, policy actions, user acceptance and stakeholder expectations.
- Disseminate the project findings widely using a variety of media.

Critical success factors from previous projects

Post-project reviews of city initiatives around Europe have highlighted a number of aspects within the overall project life cycle as having been highly influential on success:

Define clear objectives.

- *Clear objectives*, which are agreed by the project stakeholders and kept under review.
- *Thorough assessment of the most suitable technology* for the transport application in question, according to the local city context and objectives.
- *Identification of user needs* and their willingness to change behaviour with respect to any new transport service.
- *The use of proven technologies*, except in projects targeted on technology development and testing (where commitment from a local manufacturer seems highly desirable).

Test the technical operations first.

- *Allowing a period for resolving technical problems* and fine-tuning vehicle operations before starting the measurement and evaluation of user responses to a new transport service.
- *Adequate financing and project design*, so that the scale and duration of the project provides a clear demonstration of the advantages and viability of the new technology and transport concept to all concerned.
- *Talking with those who provide the funds*, both early on in the inception stage and throughout the project.
- *Setting up a simple yet effective management structure* for the project, with a clear and skilful leader.

Match the data collection to the needs implied by the objectives.

- *Matching the measurement and evaluation strategy* to the needs of the project, so that unambiguous evidence can be provided concerning the achievement of each of the project objectives.
- *Communicating the vision, plans, results and successes* to users, politicians and the public at a local level. This includes providing milestones that attract political and public interest.
- *Contingency planning* for changes in external conditions and technical risks (particularly problems with vehicles). This is based on active risk management.
- *Defining the exploitation strategy or business plan*, during the project inception, for the transition from the demonstration phase to the follow-on “market” phase. This includes actions to encourage any necessary policy changes.
- *Building strong political support*, and linking the project with the transport strategy for the city.

Involve the right people.

- *Good project partner networking*. A stable and committed network is needed which is complete in terms of the resources necessary for the project (vehicle supply, vehicle operation, fuel supply, policy support, technology expertise, project management and funding agencies). Close co-operation assists the smooth running of the project. Win-win benefits aid motivation of stakeholders.

Section 1.
What is the role of demonstration projects?

What are the different types of pilot and demonstration project?

How can projects be used to change the vehicle market?

In this Section:

- Why use a demonstration project?
- Benefits from different perspectives.

The main issues

What is the role of demonstration projects with transport solutions involving cleaner vehicles?

What benefits can be achieved by choosing to run a pilot/demonstration project?

What is the added value of co-ordination across national and European projects?

What are the main types of project illustrated in these Guidelines?

What are the problems?

At a city level, there is much political concern over the effects of traffic pollution on health. At national and European levels, there are additional concerns over the sustainability of growth in transport demand, its effects on the global environment and on economic development. For example:

- In 1995, transport accounted for over half the emissions of carbon monoxide and nitrogen oxide in the European Union, and was a major source of ozone precursors.
- Road traffic related air pollution has been estimated to cost around 300–370 Euros per capita each year in Austria, France and Switzerland, according to a recent study for the World Health Organisation.
- EC modelling work suggests CO_2 from road transport in the EU will be some 19% higher in 2010 compared to 1990, after allowing for expected improvements in vehicle fuel efficiency and traffic growth. Road freight accounts for the majority of this increase.

Uncertainties over new technologies

These concerns are leading to new types of policy action, such as Low Emission Zones in city centres and changes in fuel taxation. These changes create uncertainty (and opportunities) for vehicle operators, suppliers and other actors. What types of vehicle should be purchased to comply with future legislative constraints? Is it worth investing in new refuelling infrastructure? Do the alternative technologies perform reliably? What are the problems in refuelling?

Some of the answers to local environmental problems can be addressed through changes in technology. Advanced conventional-fuelled and alternative-fuelled vehicles offer substantial reductions in emissions. Some questions remain over real-life practicalities such as reliability and refuelling, and pilot projects are a sensible way of reducing the uncertainties for local actors.

Transforming mobility markets

However, greater challenges lie in more radical transport solutions such as rent-a-vehicle concepts, and in opening up the market for new propulsion systems. These need a combination of technology, policy and behavioural change on a larger scale. In particular, behavioural change may be the decisive factor, and the most difficult to achieve. The uncertainties are great – but so is the prize of more sustainable mobility.

Using best available technologies and new concepts for transport services, it would be possible to design a transport system that is much cleaner and more efficient than the present one. There are major problems, though, to realising this in practice, notably the following market barriers:

1. Different actors have different views on what is desirable or promising. This creates general uncertainty, as a result of which various actors try to minimise the risk of lost investment or prestige by taking only small steps at a time.
2. The alternative technologies and transport concepts have to compete with an existing situation that is deeply rooted in society in a variety of ways. For example, alternatives have to compete with existing infrastructures (e.g. for refuelling), existing investments in vehicle manufacturing facilities and support services, current consumer preferences, and existing legislation tailored to the current situation that works as barrier for certain alternatives.
3. There is a chicken-and-egg problem over the costs of new technologies. The market for new vehicles only becomes economic when the production volumes are significant. High costs for the first vehicles act as a hurdle to creating this market.

Market barriers to cleaner transport systems:
- uncertainty over the right technology;
- entrenched conventional systems;
- high entry costs.

There are also many other barriers towards the realisation of new transport solutions. These include technological, societal, economic, political, and psychological factors. They all work together to impede the practical realisation of a new solution, especially in the case of a new transport concept rather than just a new vehicle technology. This implies that these barriers have to be lowered or removed in some sort of co-ordinated fashion, taking account of various stakeholder interests.

Various strategies can be followed to tackle these barriers and change behaviour. The choice of strategy depends on the characteristics of the new alternative and the existing situation. Examples include:

Strategies to overcome barriers:
- Technology Forcing;
- Strategic Niche Management;
- Market Transformation or Stimulation;
- Fiscal Incentives.

- *Technology Forcing* – setting regulations which create a market, such as emissions regulations that can be met by only certain current technologies (e.g. Zero Emission Vehicles).
- *Strategic Niche Management* – focusing policy action and incentives on specific applications where new transport solutions and technologies have competitive advantages and face reduced barriers, and therefore may be self-sustaining once established. Initially these niches need protection (e.g. via subsidies) to facilitate a learning process involving relevant stakeholders.
- *Market Transformation or Stimulation* – working with lead suppliers and customers to achieve a critical mass of supply and demand, supported by policy and information actions to boost confidence in the sustainability of the market.
- *Fiscal Incentives* – providing tax breaks for clean vehicles and fuels, complemented by measures such as zones with access for clean vehicles only or preferential parking privileges.

When is a demonstration project useful?

The interest in demonstration projects differs between the national and European levels on the one hand and the local and regional levels on the other.

National and European policy makers are primarily concerned with demonstration projects as a component of strategy *en route* to high-level policy goals. From their perspective, projects are useful for:

High-level policy objectives

- Developing a portfolio of solutions that have been tested in practice. This portfolio can then be used by cities as a resource in selecting the most promising options to tackle local problems.
- Identifying the real-life performance of new technologies, so that they can estimate the likely environmental effects of policies that alter the market competitiveness of alternative fuels.
- Demonstrating to suppliers, local authorities, financing organisations, operators and consumers that a new technology is reliable, and providing performance data that carries a perceived Government "accreditation" (to boost market confidence).
- Changing the expectations of the market concerning the potential and feasibility of a technology or transport concept. This includes creating a positive public climate for introducing cleaner vehicles.
- Signalling to manufacturers to improve their technology to meet user needs, e.g. concerning EV range and refuelling infrastructure.
- Providing a practical test-bed of the adjustments that stakeholders need to make in accommodating a new transport solution, checking for e.g. public acceptance, stakeholder opposition, and the need for regulatory changes.
- Seeding the market with initial demand for new vehicles, so that suppliers start to achieve the economies of scale and learning that can make the market self-sustaining in the longer term.
- Identifying issues in connection with the new option that need to be addressed at higher policy levels (e.g. infrastructure and policy barriers impeding the introduction of the new option).

Example: Powershift programme for market transformation

Since 1996, the UK Government has funded the Powershift programme, co-ordinated by the Energy Saving Trust. This aims to help establish a market for cleaner vehicles in the UK, and primarily provides grants to offset the increased capital costs of cleaner vehicles (specifically vehicles powered by LPG, natural gas and electricity – including battery, hybrid and fuel cell vehicles). The programme sponsors a large number of projects with car, bus, van and truck fleets.

Example: French programme on natural gas buses

In France, a programme was launched in 1998 to test more than 170 natural gas buses in six cities. This followed the introduction of new legislation on air quality, which provided tax incentives for clean fuels. Policy-makers were interested in reducing the uncertainties over the technical and economic performance of a new generation of buses, in order to assess their viability for large-scale implementation.

Local objectives

At a local level, the emphasis is on solving local problems. Pilot and demonstration projects can be useful for:

- Testing the technologies and their economics ahead of larger-scale investment.
- Assessing the environmental and traffic flow benefits for the local situation.
- Creating awareness among local stakeholders (e.g. local industry, shop-owners) of the need to develop new transport solutions.
- Demonstrating to service providers that a new solution is practical.
- Overcoming political stalemates rooted in local disagreement over transport issues.
- Proving the viability of a new transport solution, as a contingency against future local policy restrictions on the use of older technologies and systems.
- Identifying synergies with other transport management measures.
- Image building: to demonstrate that the city is seriously trying to improve its environment and infrastructure. This may serve to improve the confidence of the population in the local transport policy, or be exploited for tourism, economic and other purposes.
- Identifying barriers to the use of the new option that might be lowered by specific local policy measures.

Example: LPG bus demonstration in Chester, UK

The local authorities in Chester were keen on introducing alternatives to diesel for public transport. To get the evidence to convince other stakeholders of the commercial viability of LPG, they ran a two-year demonstration of a single LPG bus, operating on a Park & Ride route alongside diesel buses.

The strategy for the follow-on to the project was to develop a dual tendering procedure, where bus operators were asked to propose diesel and LPG fuelled alternatives for providing the Park & Ride services. The LPG tenders had a 10% higher cost than the diesel tenders. Nevertheless, the local councils were able to argue, on the evidence from the demonstration project, that the LPG option should be accepted on a “best value for money” approach.

A new generation of commercial LPG bus routes is now in place for the next five years. The demonstration has raised the confidence in LPG of local public transport operators, and more widely across the UK (as part of a wider Government-backed programme).

In some cases, the local objectives for project development may be inconsistent with national and European goals. For example, the local level may focus on quick and easy solutions (such as bio-diesel, requiring no change in vehicle technology) instead of a solution (such as fuel cells) that may be perceived to have national advantages and greater scale-up potential.

Demonstration projects as a means of learning

A demonstration project typically aims to reduce uncertainty in some way. It is an opportunity for the project champion and stakeholders to *learn* about the technology or transport solution in a 'partially controlled practical situation', and thus test their expectations about its potential and feasibility, and fine-tune its implementation. The local application gives results that are specific to local conditions and information needs.

The cycle of learning

From a national or European perspective, there should be opportunities for other cities to pick up on the latest knowledge. This can also help government programmes to adjust their targeting. The next set of projects could then test new hypotheses and applications, in a *cycle of learning*. However, it is inherently difficult to transfer results to other sites, for a variety of reasons (physical, institutional, cultural, political etc.).

> Learning is a key feature of demonstration projects, and a project champion should always bear in mind the interest of other cities and government sponsors in the sharing of this learning.

Example: THERMIE Targeted Transport Projects

The European Commission has recently funded seven major demonstration projects, involving test sites spread across some 60 cities and a wide range of vehicle types, fuels and activities.

Cross-city and cross-project assessments were designed to enable conclusions to be drawn across the portfolio of individual applications. Nevertheless, any future programme would benefit from an even greater investment in a common and co-ordinated approach to evaluation, designed into projects right from the start, and promoted by contractual and financial incentives.

Incremental improvement versus radical change

Learning should take place on all types of barriers that impede the application of the new technology or transport solution. How high and varied those barriers are depends upon the level of ambition of the new option and the local situation.

Changes in the transport "regime"

We can distinguish two modes of evolution of the current transport "regime". One is a route of gradual *improvement*. It might lead to a transport system that still basically depends on privately owned and used vehicles, but these vehicles would be much more fuel efficient, cleaner and better tuned to the type of use. These vehicles may use conventional or alternative fuels, depending on what proves most economical. An alternative route would involve more *radical change*. This might lead to a system where urban traffic is largely based on public or private collective services.

The *improvement* route might largely solve vehicle emissions problems but will have little effect on congestion, accessibility and liveability problems (unless complemented by other non-technical policy measures such as traffic and demand management). More *radical changes* seem desirable but are much more difficult to realise and may be costly. The reason is that radical solutions imply introducing not only new technologies but also new traffic and transport concepts in which people would have to change their travel behaviour, ownership relations might change, new infrastructure might be required, etc.

Demonstrations of radical transport solutions should aim at open-ended learning.

Demonstration projects can be an important step in introducing new transport *solutions* (and not just cleaner vehicles). However, in contrast to simpler *improvement*-oriented projects, projects that target *radical changes* in the delivery of transport services have to aim at more open-ended (i.e. broad and not completely pre-determined) learning, because there are many and mutually dependent variables. In such cases a single project typically does not directly inform implementation decisions but acts as a step in a longer process of parallel and consecutive projects to learn about a new transport option.

Example: Mendrisio – learning at large scale

In the Mendrisio project on electric vehicles, *large-scale* and *long-term* testing was considered necessary to investigate the viability of battery electric propulsion for a range of applications, identify technical problems which arise only in daily use, provide publicity for new products, and evaluate promotional measures for market introduction. Some 300 vehicles had been introduced by early-2000.

Example: Praxitèle – field testing of a radical new transport solution in steps

In France, a vision has been developed for combining rail travel with self-service rental of small lightweight electric vehicles to reach the final destination - the Praxitèle concept. This requires radical innovations in technology, logistics, user behaviour and the mix of transport services. As a first step, a two-year project has been carried out to test some of the changes (e.g. using current state-of-the-art, heavyweight electric vehicles rather than lightweight vehicles). The results of this first project are intended for use in defining a follow-on project.

The project offered the general public a self-service electric car fleet of 50 vehicles, available for hire from 14 locations within Saint-Quentin-en-Yvelines near Paris. As well as proving the technical feasibility of a range of new technologies, the project explored the public acceptance of this new type of service and identified the best conditions for its commercial use.

There is no simple divide between projects focused on improvement versus radical change. Projects may primarily set their objectives to "improve" problems from a local perspective, but also recognise the interest of government sponsors in stimulating more radical change.

Relevance of demonstration projects for the national and European levels

For those responsible at national and European levels, sponsorship of demonstration projects provides a means to expand the general knowledge base on transport alternatives. As there are many alternatives, each with specific promises, drawbacks and uncertainties, it is important not to 'bet on one horse' but to stimulate a *range* of alternatives. This has several advantages:

- chances improve that one or more options will appear to be realisable in practice;
- competitive alternatives may put pressure on the existing supplier base to enhance the performance of conventional technologies;
- Governments will be better able to introduce demand-side measures (such as pricing policies) when more options are available;
- the market distortions and risks of favouring *specific* technologies can be reduced.

Portfolio management

National and European policy-makers need to maintain an overview of alternative transport technologies and concepts that are *promising* in terms of their contribution to policy objectives. Different actors are likely to have different expectations of the potential of the various options. The potential of electric vehicles is a clear case in point. It is not practical to get consensus beforehand on the 'most promising' option(s), based on desk research and expert opinions. It is better to acknowledge that there is uncertainty that needs to be clarified on the basis of practical experience. The result of this exercise is to define a *portfolio* of options, i.e. a range of new transport technologies and concepts that entail a certain promise to solve important problems of the current transport system, but that have uncertainties and potential new problems as well.

For some new transport concepts and technologies, 'promising' primarily indicates that an option fits a vision of sustainability rather than it appears commercially viable on short-term economic criteria. Where *radical* change is to be explored, it is more important to get the right partners together that believe in new options, than to do detailed cash flow analyses. Even so, these partners must pay close attention to end-users' needs, and should develop a realistic business plan or strategy for post-project implementation fairly early in the project lifecycle.

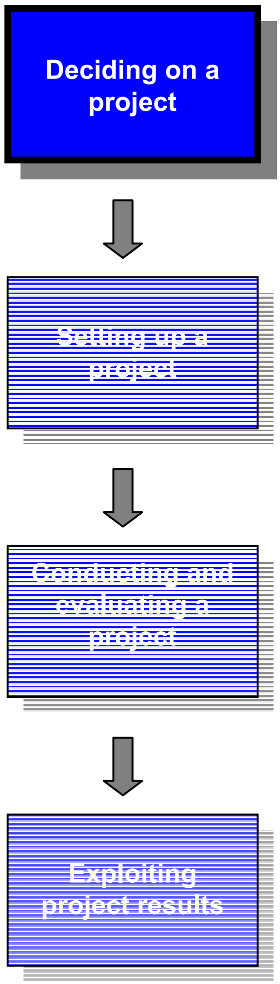
Of course, developments in Europe as a whole are centred on *gradual* improvement. In many cases, improved technologies may provide the most cost-effective solutions to environmental problems, while securing industrial competitiveness. Some of these technologies will need pilot and demonstrations, while others are commercially viable from the outset.

Good practice

Summary of good practice

In any project that seeks national or European funding, the project champion needs to bear in mind the higher-level policy goals, learning objectives and portfolio considerations. This is likely to require some evaluation work additional to local needs, and possibly some compromise with local stakeholder objectives.

Section 2.
Deciding on a project



In this Section:
- How do I build support for my project?
- Who needs to be involved?

2.1 How do I build support for a project?

The main issues

How do I build support for my project proposal among stakeholders?

Who needs to be involved in the project?

Building stakeholder support

The identification and involvement of stakeholders is a key activity of the set-up phase, since:

- Practical aspects of the project such as the definition of objectives and the preliminary design need to take account of stakeholder interests – in order to avoid opposition and to create a climate conducive to active support and participation.
- Projects aimed at exploring the potential for radical changes in the transport system require all actors to be involved (see Section 1). This is to allow the learning and institutional adaptation that are essential for a deep-rooted shift in behaviour and attitudes.

See Section 1 on projects aimed at radical change.

- Political and financial support for the project is often influenced by the strength of stakeholder involvement that can be demonstrated.
- Opposition from neglected stakeholders may frustrate the project.
- Stakeholders are a resource to tackle problems. They can contribute technical expertise, finance, other facilities and lobbying support.
- Public-private partnerships are becoming increasingly important in funding new transport initiatives across Europe.

Involve stakeholders from the start.

Stakeholder involvement must be an ongoing process throughout the project. The best way to ensure support from the actors in a project is to involve them from its very beginning and give them clear responsibilities during the project.

Who are the stakeholders in a project?

Stakeholders are all categories of people involved in, and affected by, the project. In building the network of stakeholders, the following groups may need to be enrolled:

- *Technology providers (engineering companies, start-up companies, major manufacturers, vehicle dealers and maintenance providers).* Major vehicle manufacturers have found it difficult to provide a range of alternative-fuelled vehicles with pricing competitive to conventional-fuelled vehicles, because the scale of market demand is too low. Bus manufacturers have seemed the most responsive, because of strong environmental pressures on their market, and because they are accustomed to building small numbers of vehicles to meet individual customer orders. In the case of new transport concepts such as self-drive electric rental cars, other technology providers have had a critical role in developing the information technologies that make these systems efficient and viable, motivated by the prospect of creating new markets. Vehicles may also be obtained from smaller companies specialising in fuel conversions – these companies may show greater commitment to a development project than the major manufacturers, but present a greater risk of terminating their support for the project. Ongoing maintenance support is very important from an end-user perspective. In the longer term, manufacturers have a crucial role in stepping up product sales and after-sales support as the market responds to pilot project results.

Network members:
- Technology providers
- Transport providers/ fleet operators
- Users
- Local authorities
- National/EU programmes
- Non-users.

- *Transport providers/ fleet operators.* Bus operators have proved very receptive to clean vehicle initiatives as they prepare to face the consequences of European legislation on air quality standards. Other fleet operators tend to be motivated primarily by the economics of new fuels, but with some exceptions. In the UK, for instance, there has been some interest in gas-fuelled trucks where the low noise has been used to argue for extended delivery times to supermarkets in urban areas. In Sweden, electric refuse collection trucks have held out the promise of double shift operation, with the low noise permitting evening collections. Some companies are experimenting with alternative-fuelled vans as a contingency against city centres being closed to conventional vehicles for reasons of air quality or congestion. In the UK, local authorities have been promoting Quality Bus Partnerships (where operators invest in clean buses while the authorities provide bus priority measures and new infrastructure) and Quality Contracts (where vehicle environmental requirements are included in public procurement tender specifications). These can be effective in promoting stakeholder commitment.

- *Users.* Users may be classed as "leading edge users" (who are willing to try innovative products and services) and "average customers". Clean vehicle projects typically try to target the former group. The project objectives may include an exploration of the conditions under which the innovation can be made attractive to growing numbers of average customers. Users can be identified at various levels. To the bus producer, the public transport operator may be the user. To the latter, the traveller may be the user. In between, the driver of the bus is another type of user. In a project, it is important to reflect upon the potential relevance of all these types of users, as enthusiasm as well as opposition may come from them. In various cases it may be helpful to have associations of users in the project network, such as business associations, vehicle operators' associations, and motorist and passenger groups.

Involve associations that represent user groups.

- *Local authorities.* City planners are often a driving force behind clean vehicle projects, as they try to tackle increasing problems with congestion and air quality. Alternatively, their actions may be a key influence on other actors to take the initiative to introduce cleaner vehicles. For example, extended access times, access to restricted lanes and/or roads and guaranteed parking and kerbside access may all be vital to commercial operators in offsetting higher acquisition or running costs for cleaner vehicles. In any event, local authorities are a key stakeholder group, since policy actions are often needed to overcome critical barriers to project implementation (such as planning approval for new infrastructure, approval for gas fuelled vehicles to enter enclosed spaces, and priority measures for clean buses). However, in some cities, the time frame to the next election may be rather short. This may act as a disincentive for politicians to take decisions that are environmentally positive but risk opposition from some sections of the electorate.

Discuss project ideas with programme managers at an early stage.

- *National/EU programmes.* Many projects need the financial support of national or EU programmes to cope with the current cost premium of alternative-fuelled vehicles, and to cope with the cost of learning how to use a new technology and its infrastructure. Criteria to secure support vary with the programme objectives. Experience shows that close compliance with written criteria, backed up by direct contact to understand these criteria and the portfolio strategy of the programme manager, are important ways of increasing the prospects for support. However, the complexity and expense of bidding for European funds have deterred some cities. In some instances, they have paid a skilled consultant with appropriate experience to submit their applications.

- *Non-users.* People that are affected by the external impacts of a new transport solution may need to be consulted and involved. This can help to overcome the suspicions of competing transport services and city centre shopkeepers.

Building stakeholder support

Ways to build stakeholder support include making them aware of what is happening, having experts available to provide explanations and involving the stakeholders in the decision making process of the project. It is important to make clear to all stakeholders how they will benefit, to anticipate complaints and provide evidence to lessen the impact of these complaints. Stakeholders must feel that their preferences and concerns are taken seriously.

One aspect of this is to have a clear view on the expected results from the project, what this might mean for scaling-up after the project and how this might affect various stakeholders. This comes particularly from the prior evaluation of the project design. The subsequent evaluation of the results of the project needs to be clearly presented and disseminated, so that the outcome can be checked against the objectives of the various interested parties as well as the defined objectives of the project.

Approach stakeholders individually.

Experience suggests that stakeholders should be approached individually, starting with the one that would impact the most on getting others to join. This is an approach that usually brings the most difficult questions into the open from the start. It allows problems to be debated and arguments prepared before approaching the next stakeholder. (However, at some stage, common issues will need to be resolved in a group situation.)

Where stakeholders join the project steering committee, it is important that each committee member has the appropriate rank in their organisation. Too low a rank means that no decisions are made in project meetings, while too high a rank means that the individual will usually not have time to attend the meetings.

It is not always desirable to involve every possible stakeholder. For example, competition between rival commercial organisations may block any progress. In this case, the most enthusiastic and influential stakeholders should be targeted.

Example: Development of the Alé hybrid bus in Bologna, CENTAUR project

Several sites of the CENTAUR project opted for alternative bus technologies when public calls for tender showed the high cost of hybrid bus supply. Typically, these were sites where the public transport operator was committed to implementing a *package* of measures in collaboration with the local traffic authority.

For example, in Napoli, a zero-emission bus service had been offered to the public to gain acceptance for access control in the city centre. (Electric minibuses were chosen to replace the hybrid buses.)

However, in Bologna, the public transport operator was able to secure financial support from the Municipality for the proposed hybrid bus demonstration. Together, these public sector partners were then able to interest a bus manufacturer in participating. National and European funding was also obtained. As a result of the strong focus of the local project, in which no other measures were to be demonstrated, four hybrid midi-buses were built and operated.

Many stakeholders perceive benefits in terms of public relations through local and national media coverage of the project. Therefore project champions are advised to seek publicity, for instance by staging events where the political support for the project can be paraded. Committed "high profile" stakeholders (such as the local Mayor) can also help to draw attention to the project and build support.

Public funding for a project can lend some kind of official status or "public interest" label. This can make it easier to obtain support from some industrial partners.

Stakeholder commitment

A financial support for the project, even a small one, forces stakeholders to an active participation and to stand behind the project. Another way to enrol them is to include them in a project support team that meets at regular intervals to assess progress and give feedback to the project management. This also helps to avoid adversaries and critics of the project.

Example: Stakeholder participation in the project Steering Committee

The Mendrisio EV test is supervised by an Executive Committee made up of representatives of the local council, regional council, Office of Tourism, and the main private and public sector financial sponsors.

In the Göteborg EV project, the municipality, the national power company, the local power distributor, the vehicle supplier and the Government funding agency all sat on the steering committee.

Partners may prefer to offer support in kind rather than as a direct financial contribution. For example, banks and other large institutions may have resources dedicated to sponsoring events, such as public address systems and hot air balloons.

A continuing dialogue with stakeholders is essential. Available tools for such a structured dialogue include steering committee meetings, progress reports and workshops. Projects are always likely to go against the direct interests of certain stakeholders and it is important to have this source of controversy open on the table to allow an early discussion on what seems best in the common interest.

Building wider acceptance and interest

Beyond the circle of active stakeholders, wider dissemination is useful to persuade passive users, politicians and the public to accept and take an interest in the project. The use of public funds may need to be justified to ward off potential critics. Methods include seminars, newsletters, information sessions, information points, leaflets, press articles and Web sites. At a local level, people need to know about proposed changes in traffic and services, and be informed about developments and problems as they arise.

Delay major promotion until reliable technical performance can be demonstrated.

Project promoters can learn from case studies about outreach and dialogue methods that have proved effective in the past. One key lesson is to avoid major promotion until the technical performance of the project has been proven. Some projects have also chosen to keep a low profile until the first operational results are available.

Example: Bicycle Lift, Trondheim

An ambitious opening ceremony was held at an early stage in this project. The technology had not been perfected at that stage, and unfortunately a mechanical problem led to adverse publicity. The technical issues have since been overcome and reliable performance demonstrated.

Managing the network of stakeholders

The project champion needs to actively manage the *network* of stakeholders. This is important in:

- Reaching agreement on project objectives that take account of different stakeholder perspectives, and keeping these objectives under periodic review in response to changing conditions.
- Identifying the institutional changes that are necessary for the introduction of a radically new transport solution such as electric self-drive rental cars. The idea is to increase contacts between users, producers and third parties in order to accelerate the adjustments.
- Gaining the confidence of national programmes and policy-makers that the project is responsive to programme and market needs.
- Getting co-operation between organisations over practical issues (such as refuelling of vehicles).

- Brokering agreements to share commercial information and to reach a common statement of the eventual results of the project.
- Getting a realistic perspective on the market opportunities for exploiting the project results.

It is not necessary to get stakeholders to agree on *all* details. On some issues, they may agree to disagree as long as they all can gain from working together and from the realisation of the principal project objectives.

Actions by the project champion

A project champion can enhance network development by:

- Finding certain actors who are willing to put a lot of effort into the network.
- Ensuring that the project partners collectively have the capacity (e.g. financial, technical and legislative) to reach their aims.
- Involving new actors (such as entrepreneurs who believe in a new technology, and end-users) to balance the conservatism of actors with vested interests in other technologies.
- Building trust between partners through open discussion of issues. For example, this may include setting up an explicit forum to discuss the roles and ambitions of each of the stakeholders.
- Starting the process of formulating the expected outputs from the project at the start. This allows stakeholders to make explicit the findings to which they want to give prominence, and provides guidance to the evaluation experts.

Differences between national cultures

It must be recognised that the approach towards network formation and consensus building varies across Europe, and must reflect the cultural and societal values in the area(s) within which the clean vehicle project is proposed. In some Member States (such as Scandinavian countries), it is the norm that consensus will be sought, before participants are prepared to work towards a common goal.

By contrast, in other Member States the mechanisms and culture for consensus-building are not so well developed. For example there may be a tradition of a more directive approach, as in France. In this situation, it is recommended that the actions of dissemination and dialogue are used to understand the diversity of views, and to create the basis for a future consensus.

Example: Camden Community Transport

The ASTI project introduced battery and CNG minibuses to provide door-to-door services for people in London who are unable to use conventional public transport. The fact that the lead partner, Camden Community Transport, is a co-operative organisation appears to been significant in bringing together the eight other partner organisations. Community transport operators in the UK have a culture of working in partnership with their suppliers, with public authorities and with users, which is well suited to complex demonstration projects.

Collaboration Agreement

In projects funded by the European Commission, partners are usually recommended to develop a formal Collaboration Agreement. Such Agreements have also been found essential in other situations, such as vehicle trials run by national postal services. The Agreement may define the responsibilities of each partner (e.g. in providing data for evaluation), exploitation plans and intellectual property rights. The appropriate level of detail will depend in part on the culture of each partner organisation. The process of reaching the Agreement can act as mechanism for surfacing any differences in partner aims and commitment.

Project financing

The economics of the transport solution being demonstrated, and even of the project itself, will be a key issue for many stakeholders – particularly the technology providers, fleet operators and local authorities. The typical cost premium of alternative-fuelled vehicles is often a limiting factor on stakeholder interest. Identification of the funding sources that can help to overcome this barrier is therefore essential in most cases. This needs to be done as early as possible, both to avoid wasting efforts on "no-hope" projects and to allow for the long lead times for some funding approvals.

Identify potential funding as early as possible.

The project champion may seek to justify the cost premium using various arguments (environmental benefits, operational benefits etc.). This issue is a critical one for early discussion with stakeholders.

Example: Cheshire County Council

Cheshire County Council were central to the LPG bus project in Chester. They actively sought funding from two UK Government-funded programmes to pay for the bus (at a 23% cost premium) and other infrastructure costs. Based on this they were able to get a national bus operator and a gas supplier to contribute financially to the project. The gas supplier sees benefit from the stimulus to the LPG market in the UK, and the bus operator has been able to provide an economically viable service.

Private sponsorship can help to secure public funding.

Public funding agencies often look for project proposals to include some level of financial participation from the private sector. This is seen as evidence of commitment and a market-led initiative. Therefore the early targeting of private sponsors by the project champion can be recommended.

Potential sources of project finance (external to the lead partners) include:

- clean vehicle programmes funded by national Governments and the European Commission;
- urban regeneration programmes;
- new and renewable energy and energy efficiency programmes;
- local authority expenditure programmes, such as infrastructure;
- contributions of facilities and reduced prices from stakeholders;
- charitable trusts;

- unexpected provisions in various laws (such as air quality measures) that permit subsidies and quotas for various vehicle types and transport services.

Public funding *can* incur the problem of finance not being *guaranteed* over the multi-year lifetime of the project. This is a general issue for Government-backed initiatives where budgets are often set on an annual basis.

Alignment with policy

In order to qualify for funding support and co-operation from city authorities, it is usually helpful to position the project against higher-level policy objectives. This entails defining how the project will contribute to Government policy on e.g. urban transport, greenhouse gas emissions, air quality, energy, technology and urban regeneration. (If appropriate, the project concept may be adjusted to enhance its contribution.) The project champion should identify whether the Government policy includes funding provisions and/or puts requirements on local authorities. This helps the champion to argue to a local authority how the project will help them to meet their national obligations.

Example: THERMIE demonstration projects

The European Commission funded seven major demonstration projects involving clean vehicles between 1993 and 2000. The programme objective focused primarily on the rational use of energy, linked to a broader remit to promote the use of innovative technologies. However, in many of the sixty cities, compliance with future national requirements on air quality was a major reason for exploring the potential of new vehicles and services.

Project financing and policy alignment are recurring themes throughout the early stages of setting up a project – see Section 2.2, Steps 2, 4, 5 and 6 for example.

See Section 2.2.

Stakeholder opposition

Inevitably some stakeholders will perceive that they will suffer as a result of the project. Others may have a deep-rooted opposition to the technology or transport concept being promoted. Examples include:

- taxi drivers who fear the loss of business to intermediate modes of public transport, such as self-service rental cars;
- bus operators who fear a loss of patronage if two-wheelers are promoted as an alternative to the car;
- shop owners that fear loss of business due to restrictions on cars in a limited access zone;
- journalists that are sceptical of new technologies.

Example: Coventry electric vehicle fleet

The Coventry EV project introduced 14 electric cars and vans, with the potential for more to follow. Coventry's blind community have reportedly expressed their worries to Coventry City Council about the lack of noise from the vehicles, and also about the increase in pavement "furniture" with the introduction of re-charging units around the city.

Example: Praxitèle electric car fleet

At the start of this project, the taxi driver co-operatives threatened to resist the introduction of self-drive electric rental cars. However, the project was able to prove that direct competition did not arise. Results show that Praxitèle is mainly attracting private car and bus users. The taxis can actually increase their client base by providing services whenever no self-service cars are available.

Opposition can be countered by providing evidence (e.g. from earlier case studies) of the expected effects of the project, and by building positive support from other influential stakeholders. For example, the Le Touc electric vehicle project signed an agreement with the local authority in Toulouse to authorise their new transport service for shoppers going to and from a supermarket. That effectively blocked any reaction by bus and taxi operators. Concerning limited access zones, there are many examples where this has made these parts of cities more attractive to the public and increased business.

The role of the project champion

One or two strong project champions can be identified for most of the projects that have been successful in the past. The champion has particularly played a role in getting the project launched. Sometimes the lead responsibility has been passed on to someone with more specific project management skills for the design and implementation stages.

Each phase of a pilot or demonstration project needs a strong and enthusiastic leader. It doesn't have to be the same person for each phase – different personal styles may be appropriate for the political negotiations to set up a project versus the effective implementation of the project once approved. Changes in the management can be a good opportunity to adapt the design of a project to changes in the external conditions. Nevertheless, changes in the project management should not be abrupt, but be carried out as a carefully planned process, if possible with a period of common leadership by the two managers.

Characteristics of successful project champions

Experience across Europe has shown that successful project champions often exhibit the following characteristics and skills:

- a strong vision for the project, and good communication and social skills;

- the ability to win the trust of a range of stakeholders;
- staying power.

Management skills

In some circumstances, a project will run more smoothly if the project management is neutral from the stakeholders. In this case, the project champion (e.g. from the leading partner) may choose to hand over to a hired manager. Such a manager requires:

- professional skills in planning and people management;
- the ability to talk/write to a wide variety of people;
- the ability to see "the big picture" as well as understanding the technical issues;
- negotiation skills;
- an aptitude for financial and time control.

Example: Bicycle Lift, Trondheim

The engineer who developed the concept of an electric-powered lift to assist cyclists ascending a steep hill has also championed and managed its first implementation. Technical skills were vital for overcoming teething troubles, and good local contacts were important in securing stakeholder support.

Summary of good practice

Good practice

Recommended good practice for stakeholder participation is as follows:

- Involve stakeholders in the project from the very beginning.
- Invite a range of stakeholders to take part, whether as project partners or in a more advisory role. This includes the representatives of users and non-users.
- Approach stakeholders individually, starting with the one that would impact the most on getting others to join.
- Establish a formal collaboration agreement, defining stakeholder responsibilities.
- Set up a forum where stakeholders can discuss their ambitions and roles.
- Have a continuing dialogue to review objectives, progress, results and exploitation strategy.
- Aim to secure financial and other resource inputs from stakeholders that will encourage them into an active participation.
- Where national or European funding is requested, identify how the local project must reflect higher-level policy objectives and evaluation requirements.
- Involve stakeholders in project publicity, but avoid premature and over-optimistic launch publicity.
- Disseminate project news more widely to politicians and the public.

In this Section:

- How do I work out whether a demonstration project is appropriate in my city?
- What should I consider in setting the objectives?
- What should I consider in making the go/no-go decision?

2.2 How do I decide on a project and set its objectives?

The main issues

How do I work out whether a pilot or demonstration project is appropriate (in my city)?

How should I set the overall objectives for my project?

How do I assess the options? What should be considered within the preliminary design of the project? What initial evaluation is required in order to make a go/no-go decision?

Nine practical steps

Before starting a project, a number of steps need to be taken. These should help to ensure that it gives results that tackle the problem at hand and in a (cost-) effective way. These steps are listed below and elaborated in subsequent Sections.

Involve stakeholders at appropriate steps.

It is good practice, and in some cases a critical success factor, to involve stakeholders at appropriate steps in this process. This includes securing a degree of consensus on the problems to be addressed, the objectives of the project, the user needs and the preliminary design. Gaining their active participation, through funding and contributions in kind, is even better. This is discussed in more detail in Section 2.1.

See Section 2.1 on stakeholder involvement.

The steps below are shown as consecutive, although there is likely to be some iteration and overlap between them.

1. Define the problems to be addressed.
2. Identify alternative solutions (some involving transport concepts with cleaner vehicles), and prioritise.
3. Identify whether a pilot or demonstration project is appropriate in introducing the targeted solution to the problem.
4. Define the objectives for the project.
5. Identify the options for the project (test applications, vehicle technologies etc.) and prioritise.
6. Define the *preliminary* design (site selection, technology choice, key parameters and methods for evaluating the project, financing and resource requirements etc) and relate it to user needs.
7. Make the initial evaluation of the proposed project and the implementation opportunities after this pilot phase.
8. Refine the objectives and preliminary design as necessary.
9. Make a go/no-go decision on whether to proceed to *detailed* design of this specific project.

Site selection may be part of the pre-design or part of the full design (see Section 3.2) after the initial approval has been given for a demonstration project.

See Section 3.2 on site selection.

National programmes may go through a similar process in defining the requirements for projects, with sites being selected from bottom-up proposals after the go/no-go decision has been taken on the principles of project selection.

The set-up phase often takes a long time, even several years. In part, this reflects the typical lead times for obtaining approvals from funding agencies.

Are all these steps relevant to every project?

The Guidelines present the lifecycle stages in a linear form for ease of finding information.

We do not expect *real-life* projects to follow this linear model of the process. Rather, there will be overlap and iteration between the various stages, and some of the steps may need to be merged or taken in a different order. It is essential to treat these Guidelines as advisory and not prescriptive.

We also recognise that projects arise in a variety of ways. Some are driven top-down by policy needs. However, many arise in a bottom-up way, where an entrepreneur spots an opportunity to use a new technology. The Guidelines aim to accommodate this variety, but cannot hope to provide a step-by-step action list for every situation.

For completeness, we have chosen to base the Guidelines on the full sequence of steps for identifying projects from transport problems and policy objectives. Some of these initial steps may appear superfluous to a bottom-up project, which usually starts with the definition of project objectives. Nevertheless, it is often advisable for such projects to map back onto local transport issues in order to justify the innovations to users, sponsors and regulatory authorities.

Even for projects that are not driven by policy, a mapping onto policy objectives can help public relations.

Step 1: Define the problems to be addressed

The clear identification of the particular transport and environmental problems to be addressed is vital for the success of a pilot or demonstration project; they will be the focus for the formulation of project objectives and hypotheses. The problem definition should be recorded together with the objectives.

Example: LPG bus demonstration in Chester, UK

In 2005, UK local authorities will have new statutory duties to maintain air quality standards within prescribed limits. Therefore city authorities are very keen to demonstrate cleaner vehicle technologies and work with transport operators to ensure that cleaner options will be in place should vehicle restrictions (such as Low Emission Zones) be necessary for conventional technology in 2005. The fleet operators want to be certain that they have vehicle options with adequate performance, known costs and emissions benefits.

To meet this challenge, Cheshire County Council wanted to stage a long-term demonstration to prove that LPG buses are a clean, viable and cost-effective option for use under local conditions. The strategic target was to get commercial operators to offer LPG in future tenders to provide bus services in the city.

Different stakeholders probably will have different perceptions of the problem. This needs to be discussed and made explicit, in order that consensus or compromise can be reached on a joint course of action that has benefits for all. Otherwise the project may encounter opposition later, or may be subverted by hidden objectives.

Example: Le Touc shuttle for shoppers, Toulouse

The Casino supermarket chain introduced a free shuttle service by electric vehicle for local shoppers at a city centre store in 1998. The local authority was trying to limit the use of cars in the city by reducing the number of parking places. On the other hand, the supermarket felt it had to act to counter the transfer of shoppers to stores on the city periphery. Therefore a contract was placed for a new demand-responsive service, provided by a specialist company.

Links to local plans

The assessment of user needs for transport services and the evidence of failings in the current system (congestion, pollution etc.) should be at the core of the problem definition. The needs of the local economy, the travelling public and local residents should all be weighed up. This analysis may already exist within a local transport plan or air quality action plan.

Example: Electric vehicles in Skåne

The Skåne project involves 100 electric vehicles and has three main stakeholders, each with a different interest:

- The Malmo city council focuses on the reduction in pollution within the city.
- The regional utility company Sydkraft is mainly concerned with proving the technical performance of refuelling infrastructure and the service infrastructure for electric vehicles.
- The Government R&D agency KFB aims to guide Swedish demonstration projects to yield complementary results.

The project Steering Committee has played an important role, acting as a forum for these stakeholders to build a shared vision for the project.

Most demonstrations of cleaner vehicles can be traced to two origins: public and policy concern over the impacts of the existing transport system; and uncertainty over technological innovations and the effects of related policy measures. Examples include:

- city centre air quality, linked to concern for public health and historical buildings;
- the noise nuisance of urban delivery vehicles;
- new legislation on air quality and local transport planning;
- opportunities provided by new enabling legislation for Low Emission Zones and Quality Contracts (e.g. in tendering to provide bus services);
- the challenges that access restrictions could pose to fleet operators;
- uncertainty over the performance and costs of competing new bus technologies such as ultra-low sulphur diesel and particulate traps versus compressed natural gas;
- national concern over traffic growth and climate change.

Projects derive from:

- concern over the impacts of transport;
- uncertainty over technology and policy options.

Example: Hybrid buses in Bologna

In 1996, a traffic plan in Bologna established the restriction of the city centre to private traffic, and introduced other measures to tackle congestion, noise and pollution. This forced the local bus operator to increase efforts to substitute diesel buses with alternative fuelled vehicles. The municipality had some doubts over the capital costs and the lack of maturity of the hybrid bus technology. The operator had some concerns over vehicle reliability. A demonstration project with four hybrid buses was seen as the way to resolve these issues.

Links to higher level policy objectives

Where public funding is involved, a reference to higher-level policy objectives becomes an essential part of the problem definition. These policy objectives are usually stated in the definition of the logic and selection criteria for the funding programme. Moreover, even where national or European funding is *not* being sought, considerations such as Agenda 21 and the need to gain public acceptance for a project may dictate some reference to non-local problems such as greenhouse gas emissions.

Summary of good practice

Good practice

Recommended good practice in defining and specifying the problems is as follows:

- Put down on paper a first statement of the obvious local concerns to be addressed (that first stimulated this analysis).
- Think more widely about the policy context and the objectives of potential funding programmes.
- Consider the perspectives of the range of potential stakeholders and transport users.
- Draft a problem definition and obtain stakeholder feedback.
- Develop an agreed statement of the problems and their relative importance (before starting to define solutions).

Step 2: Assess alternative transport solutions

Clean vehicle projects have an underlying environmental motivation. But there are other measures that can yield environmental benefits without requiring new propulsion systems to be deployed:

- *reduce transport demand*, e.g. through tele-working, tele-shopping or urban planning to reduce travel distances;
- *use vehicles more efficiently*, e.g. through optimising travel routes, improving freight logistics, car-sharing or shifting from private car use to mass transport, bicycles or walking;
- *reduce vehicle emission rates*, e.g. through end-of-pipe technologies, lighter and more aerodynamic vehicles, improved driving techniques and vehicle maintenance, cleaner and more efficient conventional engines (as well as new propulsion systems and fuels).

Measures to help the environment:

- reduce transport demand;
- use vehicles more efficiently;
- reduce vehicle emission rates.

The possible measures must be related back to the problem definition. For example, if city centre congestion and air quality is the main issue, possible transport solutions include Low Emission Zones, car and goods delivery restrictions, pedestrian zones, parking restrictions, Park & Ride and more attractive public transport. In this case the use of alternative fuelled buses as part of an overall improvement in public transport has to be compared with more restrictive measures, in terms of effects on traffic levels, pollution reduction, public acceptance and the city centre economy.

To select the most promising solution, two steps need to be taken: (1) to make an inventory of possible solutions and (2) to choose the one that fits the local problems the best. The latter step may be difficult in view of the many uncertainties concerning the various alternatives and the wide range of assessment criteria to be taken into consideration.

Incremental versus radical change

A major dilemma may arise in having to choose between:

- solutions that could be realised in a relatively short term, which may give some relief but which are not likely to give sustainable benefits over the longer term;
- solutions that look very promising on paper, but which require more time, resources or behavioural change for successful implementation and therefore may not be viable.

Example: CityCar project in Martigny, Switzerland

The CityCar project provides 30 self-service compact electric vehicles for public use. There are major uncertainties over the performance of the vehicle technology and information systems as well as the user behaviour. Therefore the focus of the project is on piloting the transport concept, rather than making a market test.

It is important to discuss with local as well as higher level stakeholders whether an assessment and further exploration of the more profound solutions is desirable. Important considerations in these discussions are the urgency of the problems in the present situation, the expected benefits of alternative solutions, and the expected amount of funding that can be obtained. For example, broader transport solutions may have a longer-lasting effect on air quality than simple technological substitution in the face of continuing growth in traffic. Initiatives that focus on longer-term solutions may be of interest to other cities, which might create additional opportunities to obtain funding from national and/or European levels.

The first assessment of possible solutions should be broad, avoiding "lock-in" to the solutions favoured by specific local stakeholders. Local interests inevitably will come into play at a later stage, but should not be allowed to rule out innovative and contentious options prematurely.

Uncertainties over the likely performance of each alternative mean that the choice of strategy is never unambiguous. Pilot and demonstration projects are often conducted precisely to help resolve such uncertainty. Moreover, it may be important to limit the assessment and come to action quickly, in order to avoid losing political or stakeholder momentum.

An analysis of alternative transport solutions may already exist as part of a local transport plan or air quality action plan.

Example: Leeds guided busway

The Leeds Transport Strategy advocates a light rail network to provide services on main radial routes not served by the existing local heavy rail network. However, the high cost means that this cannot proceed at present. Therefore the focus has switched to guided busways as a relatively cheap option that offers some (but not all) of the benefits of a light rail system. A demonstration busway has been packaged with high quality passenger infrastructure and improved information systems to raise the image of public transport and compete more effectively with cars. An alternative approach would have been the use of on-board transponders to give traffic signal priority, but this did not permit the buses to bypass queues of traffic.

Criteria for assessing alternative solutions

The following Table 2 provides a list of criteria that may be used as a framework for the assessment of alternative transport solutions. The list is neither prescriptive nor exhaustive. Rather, it is intended as a guide to the range of (inter-dependent) issues to be considered, based on the experience of previous projects. It is up to the local decision-makers to decide what weighting should be given to each criterion in the specific city context. Different stakeholders will give different weightings to different criteria, and some process for reaching agreement will be needed. Some of the criteria relate primarily to the transport service, and some to the performance of the specific vehicle technology.

Table 2. Criteria for assessing alternative transport solutions

Broad criteria	Sub-criteria	Specific aspects
Cost	Capital cost	Vehicle purchase cost and resale value, land, infrastructure, equipment, training
	Operating cost	Vehicle, fuel, maintenance
	Available subsidies	Costs of proposal submission
	Effect on the unit production cost and the price of the transport service	
Environmental impacts	Local pollution	Air pollutant concentrations for individual species such as NO_x and PM
	Greenhouse gas emissions	CO_2 and methane emissions
	Primary energy use	Use of renewable energy, fuel efficiency
	Noise and vibration	City centre and night-time disturbance
	Effect on physical fitness	Use of non-motorised transport
	Visual intrusion and community severance	Effects on the townscape
Socio-economic and traffic impacts	Accessibility of transport services and destinations	Effects on land use
	Congestion	
	Competition between modes of transport	Use of public transport
	Employment effects	Job creation, city centre trade, working conditions
	Social equity	Access to public transport, care for disadvantaged groups
	Quality of urban life	
	Freedom of choice	
Operational implications	Service performance	Reliability, capacity
	Technical performance	Range, speed/ acceleration/ braking, ease of refuelling, compatibility with existing systems,
	Training and adaptation	

Broad criteria	Sub-criteria	Specific aspects
Acceptance to:	Policy-makers and planners	
	Consumers of transport services	Public transport passengers, producers and recipients of goods
	Providers of transport services	Drivers and operating staff, company managers
	Other users of the transport system	Car drivers, pedestrians and cyclists
	Other stakeholders	Shopkeepers, local employers
Perceived risks of different options	Safety and security of operatives and travellers	Effects of changing technology or changing modal shares
	Commercial risks	Uncertain costs and demand
	Technical risks	Uncertain reliability or vehicle range
	Political risks	Political commitment to support for specific fuels over the longer term
	Market maturity	Maturity and availability of technology, access to co-operative suppliers and maintenance services, access to spare parts, expectations for the development of the market for this transport system/technology/fuel, refuelling infrastructure availability
Policy factors	Availability of fiscal incentives	Vehicle purchase subsidies, fuel tax differentials
	Alignment with policy trends	Government leadership in “green” purchasing
	Conformance with policy mandates	Requirements for clean vehicle purchasing
	Opportunities to support or be supported by other policy measures	Low Emission Zones. Quality Partnerships
	Regulatory barriers, lack of regulations	Effects of planning regulations on infrastructure provision
	Perceived intangible benefits	Prestige of city, opportunities for city networking, image to attract inward investment

Example: "Navigate UTOPIA"

Within the UTOPIA research project that produced the current Guidelines, a software tool has been developed to help local decision-makers assess alternative transport solutions based on cleaner vehicles. The Web-based tool (http://utopia.jrc.it/) includes multi-criteria decision support, based on factors such as those given in Table 2.

Summary of good practice

Good practice

Recommended good practice in assessing alternative transport solutions is as follows:

- Identify viable alternative strategies that address the problems of concern.
- Collect information on the various alternatives from a variety of sources (experts, Internet, experiences elsewhere).
- Estimate the relative cost-effectiveness of alternative strategies in tackling the specific problems within the local city context. This may include modelling the effects on emissions and air quality.
- Relate the strategies to the needs of the transport users.
- Assess ways of funding the various alternatives.
- Make an inventory of the barriers to realisation of the various strategies, including social, technical and economic barriers.
- Identify influencing factors such as acceptance by the various stakeholder groups (fleet operators, other road users, general public, shopkeepers, policy-makers etc.).
- Assess whether a transport solution involving cleaner or alternative-fuelled vehicles has the potential to make a significant contribution in overcoming the stated problems.
- Record the main uncertainties concerning the performance of the cleaner vehicle option(s) and any associated policy measures.
- For the cleaner vehicle option(s), identify the route to achieve a sustainable outcome (e.g. as part of a commercially viable transport service) within an acceptable time frame.
- Discuss the various options and major dilemmas with relevant stakeholders.
- Choose the option(s) to pursue, for example using a multi-criteria analysis across the factors listed above in Table 2.

Step 3: Identify whether a demonstration project is appropriate for the transport solution of interest

At this point, the Guidelines assume that a transport strategy involving cleaner vehicles has emerged from the previous analysis as a front-runner.

The next step is to consider whether a pilot or demonstration project is required to help introduce the strategy/solution of interest. Undertaking a project can take a great deal of time and resources and it is therefore important at an early stage to ensure that this is the right way forward. Also, some initial assessment of the availability of funding for the demonstration phase is usually helpful at this point.

Pilot or demonstration projects usually aim to test and collect information about the performance and effects of an application before it is implemented on a large scale. (This applies both to vehicle technologies and to non-technical policy measures). This is because some groups of people need to be convinced about the viability of the transport solution being tested before full implementation can take place, or because learning and adaptation is needed. Otherwise it would be possible to proceed immediately to full implementation.

Four alternatives to a project:
- do nothing;
- preliminary study;
- non-technical policy measures;
- full-scale implementation.

There are four main alternatives to implementing a project that involves cleaner vehicles:

First there is the option to 'do nothing', i.e. leave the current transport system unchanged. This option is, however, unlikely to solve the identified transport problem.

A second option would be to carry out a preliminary study and literature review of results from similar projects, as the precursor to further action. This saves resources, helps to avoid known problems, and can indicate the likely impacts from the project and subsequent scale-up. This option should therefore also be part of the initial evaluation of the project under consideration.

A third option would be to select a set of non-technical policy measures that would *not* target the introduction of a new propulsion system. This might mean, for example, sticking with conventional vehicles but increasing the traffic reduction measures in order to tackle the same set of problems. However, the same uncertainties and lack of stakeholder consensus may be encountered with non-technical measures, again requiring small-scale piloting.

The final option would skip the demonstration phase and proceed directly to full-scale implementation of the technology and associated measures (such as full-scale replacement of a diesel bus fleet with CNG or LPG). This higher-risk option may be appropriate if there is good reason to be confident of the direction and scale of the impacts. This is rarely the case with innovative vehicle/propulsion technologies and new transport concepts.

Criteria for deciding on a project

The following criteria may be used in deciding on the need for a pilot or demonstration project:

- Is sufficient information available on the alternative transport solutions to indicate that a solution based on new propulsion systems is an attractive and viable option? *If so:*
- Does this solution have the potential to offer the most (cost-) effective way of dealing with the defined problems? (This may refer to the effects of the pilot or, more likely, a subsequent scaled-up application of the technology or transport solution.) *Or:*
- Does this solution have the potential to offer the most sustainable way of dealing with the defined problems? (For example, the change in travel patterns and behaviour associated with a new transport concept may have more long-lasting effects than a fine-tuning of traffic management systems that only encourages more people onto temporarily less congested roads.) *If so:*
- Are the risks associated with immediate full-scale implementation of the technology too high? Are the benefits of full-scale implementation too uncertain? Will a pilot project help to resolve these risks and uncertainties? *If so, then a pilot may be recommended.*

Example: Electric vehicles in general

Expert opinions vary widely on the potential of electric vehicles (EVs). The automotive manufacturers see little prospect for significant market demand as EVs do not replicate the performance of a conventional vehicle and are not competitive in the private car market.

Nevertheless, various towns and cities see EVs as having some potential in fighting local pollution. In their view, the different characteristics of EVs could be exploited to change the behaviour of travellers. This has led them to suggest a variety of new transport concepts involving EVs. As these have yet to be proven, the best approach is first to explore these options in pilot projects. Two examples are:

- the Touc ‘shopping shuttle’ in Toulouse (transporting people to and from a supermarket in a small electric vehicle derived from a golf cart)
- the Praxitèle self-service short-term rental scheme near Paris (using an electric version of a standard car, fitted with advanced systems for managing the service).

Summary of good practice

Good practice

Recommended good practice in assessing the need for a limited demonstration of the favoured transport solution is as follows:

- Assess whether the chosen solution looks sufficiently promising to be sustainable in the longer-term (e.g. in the absence of temporary Government grants and tax subsidies).
- Assess whether the chosen solution is likely to be the most cost-effective option in delivering the targeted benefits such as emissions reductions.
- Assess whether uncertainty over the implications of full-scale implementation necessitates carrying out a small-scale trial.
- Determine how a pilot project would lead to further implementation opportunities.

Step 4: Define the objectives for the project

Project objectives should be determined on the basis of the problems being targeted and the needs of stakeholders involved in the project. There should be a clear link to the strategy for exploiting the project outcome.

The initial set of objectives may be based on a general perception of stakeholder needs. As the preliminary and detailed designs of the project are developed, though, the specific objectives of the stakeholders involved need to be discussed with them. As many stakeholders as possible should see potential for personal benefit.

For instance, city planners may think a limited access zone with an electric shuttle could be beneficial for everybody, and make the city centre more attractive for shopping. Shop-owners, however, may not share this expectation and may attempt to prevent the change. It will then be wise to include them in the definition phase to ensure their concerns are reflected in the objectives, design and evaluation of the scheme.

Example: LPG bus demonstration in Chester, UK

The local authorities wanted to promote the use of Park & Ride facilities to reduce congestion and traffic pollution in the centre of Chester. In order to increase public acceptance, the use of clean fuel buses was proposed, starting with a two-year demonstration of a single LPG bus. Project objectives were defined as follows:

- To increase the profile of cleaner fuels among the public and bus operators.
- To obtain a realistic in-service evaluation with comparable diesel buses used in parallel.
- To lay the foundations for more clean buses in the future, by providing credible evidence of the benefits available.

Example: Open discussion of objectives

In the Linköping biogas bus project, Scania and Stockholm Transit were approached as potential stakeholders (i.e. major bus supplier and influential bus operator). The potential for conflict over their interest in developing ethanol as a bus fuel became apparent. So they withdrew from the project and were replaced by stakeholders that unambiguously supported the biogas option.

Modest objectives

If the level of ambition is modest, such as simply replacing a propulsion system with no accompanying changes to the transport system, objectives can often be rather specific and set unilaterally by the actor responsible for the project (usually with input from the experts to be engaged in the project). This is especially so if this actor is also responsible for scaling up the application if the project renders the desired results. (However, stakeholder *consultation* is still desirable.)

Ambitious objectives

If the level of ambition is rather high, such as the introduction of a transport concept like a public rent-a-vehicle fleet, objectives should not be set unilaterally. Radical change implies that various actors will have to change their behaviour significantly and these will have quite different interests and priorities. To set objectives in such a case, an attempt should be made to get commitment from the most crucial stakeholders, implying that the definition of objectives should be subject of interaction between them.

Define objectives against which outcomes can be unambiguously measured.

Some care is needed to avoid the objectives becoming generalised and non-specific in an attempt to accommodate different stakeholder views. It is better to define objectives against which outcomes can be unambiguously measured, than to have non-controversial objectives that allow stakeholders to present conflicting interpretations of the project results.

Example: Electric buses in Bristol

Two electric buses have been used on a Park & Ride service in Bristol. The main objective was to test a vehicle that, at a *major* scale of fleet substitution, could contribute significantly in reducing city centre pollution. (The contribution to air quality *from the project* was not the issue.) The second objective was to decrease the modal share of cars by providing an attractive bus experience and an attractive Park & Ride service.

A subsidiary objective was to improve transport accessibility to the central area of the city, working with other measures to compete with out-of-town developments.

Statement of objectives

The explicit definition and recording of the complete list of objectives is essential to allow the subsequent design, progress and evaluation of the project to be checked for their ability to deliver against the objectives. Making the objectives explicit helps in managing stakeholder expectations and contributions, and provides a forum for resolving differences in the objectives of different parties.

The written statement of the objectives should be short and easy for everyone to understand.

A clear understanding of the present challenge and the longer-term strategy is important in identifying e.g. the appropriate scale for the project, the types of user to be targeted and the project duration.

Example: Objectives for multiple site demonstration projects

Large-scale, multiple site demonstration projects often have more than one objective – and the pursuit of different objectives at different sites can lead to divergent solutions being implemented. For example, the objective of introducing hybrid buses in the CENTAUR project was set within a more general target of maximising energy savings. Four cities originally proposed to use hybrid technology, but they found this would involve significantly greater costs than had been envisaged. This led three of these four cities to put forward alternative packages of measures and vehicle technologies, on the grounds that this would maximise energy savings from the project.

Project partners must be prepared to modify the objectives over time. Revised objectives should be checked against the context of the problem to be solved and the intended contribution of the project to finding a solution for that problem. Revised objectives should always be recorded and communicated to those involved.

Be prepared to modify the project objectives over time.

Example: Revision of objectives

In the Praxitèle project, one of the initial objectives was to test an inductive charging system for the electric cars. However, the system proved sensitive to the alignment of the cars with the charging stations, and Praxitèle staff had to make many trips to help inexperienced drivers achieve the correct alignment. Another project objective was to find the best conditions for commercial exploitation of the self-drive rental car concept. This objective could not be explored to its limits while the charging problems were taking so much resource. Therefore the cars were switched to cable recharging in the latter part of the project.

In the Swedish bio-fuels programme, the focus changed from local to global emissions as policy priorities changed over time, and bio-gas became increasingly important.

It can be useful to map local objectives against national and European transport policies to show that the local approach to be tested in the proposed project is consistent with higher level strategies. This is important in:

Relate local objectives to higher-level policy objectives.

- Securing political support at a local level, for example where local authority funding for the project has to be obtained from, or sanctioned by, central government.
- Increasing the prospects for direct government funding. Often the funding criteria will require any bid to demonstrate coherence with the policy objectives encapsulated in the programme definition (or "intervention logic").
- Helping the project team eventually to map the results and initial exploitation onto the (potential) impacts on broader policy objectives. This is useful in dissemination and publicity, and in reporting "success" to national and European sponsors. (The point is that the

framework for such evaluation needs to be built into the project from the start.)

Learning can be a critical objective from a national/European perspective.

- Raising the profile of learning as an explicit objective in cleaner vehicle projects. It is important to remember that a project "failure" from the perspective of local actors involved in it can still be a great success from a national or European perspective. The "success" is in terms of learning from what went wrong, or in terms of being able to assess the real potential of a new technology.

Typical objectives for a project

The following objectives are commonly encountered in projects with cleaner vehicles:

- To test the technical performance of some new technology under real-life conditions.
- To determine the potential for energy and emissions savings per vehicle.
- To learn about or prove the operational feasibility and benefits of a new transport concept or service under real-life conditions, including the ways in which organisations have to adapt and overcome barriers.
- To identify and increase the public acceptance for a new transport solution.
- To determine the best conditions for commercial application of a new transport concept or service, or a new fuel.
- To gather the knowledge required for the wider use of a transport solution in other cities.
- To identify the most effective packages of non-technical measures to promote the use of a new transport solution.
- To increase the image and patronage of public transport, and promote the switch from cars as part of a broader traffic management strategy.
- To stimulate suppliers to provide a new technology, or to provide it more cheaply.
- To improve air quality.
- To identify the environmental benefits of subsequent full-scale application of the demonstrated technology.
- To reap spin-off economic benefits in terms of urban regeneration, tourism and access for local industry.

These underlying goals may form the basis of the defined project objectives, but need to be replaced or supplemented by a more specific set of targets that can form the basis for an unambiguous evaluation.

Difficult project objectives

Experience has shown that the following types of objective are difficult to achieve:

- *To improve air quality*. Typically a project is too small to make a significant contribution in reducing total vehicle emissions in an urban area. Experience has shown that much greater benefits come from a package of measures aimed at traffic reduction and promoting a switch to public transport. Alternative-fuelled vehicles can contribute to this package by improving the image of public transport, even though the specific vehicle effect may be small.

- *To prove the commercial potential of a new transport concept*. Typically there are many aspects of a new transport concept that are far from commercial viability. Vehicle and other technologies may be at the prototype stage, consequently capital costs are high and reliability is limited. Users need (much) time to adapt to the new concept, so patterns of demand are uncertain and cannot be reliably identified by asking the users about their expectations. Organisations and policies may need to be adjusted.

Summary of good practice

Good practice

Recommended good practice in defining the project objectives is as follows:

- Define and disseminate a statement of objectives that (a) is short and easy for everyone to understand, and (b) specifically addresses the problems to be tackled.
- Involve stakeholders (including end users) in setting objectives.
- Relate the objectives to the exploitation strategy for implementation opportunities after the pilot phase.
- Ensure that the objectives are suitable for direct investigation and evaluation, if necessary by modifying or dropping objectives.
- Review and be prepared to modify objectives during the course of the project.

Step 5: Assess the options for the demonstration project

In assessing the options for the project, there can be some overlap with the assessment of alternative transport solutions discussed previously in Step 2. For instance, some of the questions concerning vehicle choice may be common to both steps. The main difference is in the *scope* of the two assessments:

- The assessment of solutions will include non-technical approaches such as traffic management and demand management. Cleaner vehicles are only one among a number of alternatives at this stage.
- In contrast, the project assessment focuses on the particular issues for a vehicle demonstration, looking in more depth at how to make the *project* a success. It lays the foundation for the development of a specific project design, described later in Step 6.

Assessment factors

Compare the costs, benefits and operational implications of different technology options.

At the project level, the following aspects need to be considered:

- What are the mandatory requirements (e.g. for environmental performance) that can be taken directly from the project objectives?
- What are perceived to be the relative advantages and disadvantages of alternative new propulsion systems, the existing technologies and advanced conventional technologies? How do they relate to the problems addressed by this particular project?
- What are the approximate relative financial costs and other resource requirements of different project options? What are the consequences of any resource limitations facing the project?
- What are the funding possibilities for the pilot phase?
- What aspects of the local context will assist or hinder the demonstration project? For example, what are the effects of stakeholder interests and site availability?
- What are the implications of national and European policies and programmes? For example, involving other cities in the initiative may attract government support and can give better access to similar work in other cities. However, as a quid pro quo, the project may have to take account of programme requirements for technology choice and data collection.
- If a "unique" option is being considered, what is the justification or reason for obtaining results that are potentially difficult to transfer or compare credibly to other cities?
- How are local authorities and other organisations (e.g. supermarkets) seeking to influence the environmental characteristics of vehicles used by transport service providers and the general public? How do they propose to do this, and how might this be promoted or strengthened in the future? What implications does this have for the vehicle options to be considered for the demonstration project?
- What policy measures are needed as part of the project to achieve a desired modal shift away from the private car?
- What are the relative risks of different options?

Project risk management: pre-selection stage

Risk analysis is vital when piloting the use of new vehicle technologies and transport services. The first stage of formal risk assessment and risk management planning for a demonstration project should be made *before* a specific option is selected. This is an overall risk identification, covering key issues such as:

- Are the objectives clearly defined and commonly understood by all partners?
- What risks are inherent to this type of project?
- What will be the most difficult areas of the project to achieve the necessary performance (technically challenging, cost-intensive, time-critical)?
- What is the dependence on external factors (policy changes, public acceptance, financing)?

A structured assessment should be made in which the main risks are identified (source, likelihood and consequences), and measures defined to deal with critical issues. At this stage, typically only a qualitative analysis is appropriate. Critical risks are likely to include late delivery and technical problems with vehicles, the operational adjustments for new refuelling, driving and maintenance procedures, user acceptance, regulatory hurdles and finance.

For example, it may be judged necessary to increase the technical or political strength of the project consortium, avoid unproven technologies, or define a minimum size of project that allows modal shift objectives to be measured.

Many clean vehicle projects include modal shift away from the private car as an objective, either explicitly or implicitly. In these cases, the assessment of policy options to form part of the project package is critical. Evidence from European Commission research projects indicates that "pull" measures such as improved public transport *on their own* have little effect on modal share. "Push" measures to constrain the use of cars (such as parking restrictions and pricing measures) have much more effect, providing alternative transport services are available, and the combination of "push" and "pull" measures is yet more effective.

The project champion usually initiates the assessment of options for the project. This forms part of the overall justification to be presented for the go/no-go decision on the project proposal.

Assessment criteria

The appropriate criteria for evaluating and comparing the options include:

- the likelihood of achieving success against the most critical outcomes defined by the project objectives and the underlying problems to be addressed in the city – such as reducing the emissions of key pollutant species that exceed local air quality standards;
- the relative cost-effectiveness of the options in delivering the critical outcomes;
- the prospects for success in achieving a viable outcome beyond the demonstration phase;
- the likely availability of funding for the different options.

Example: Criteria for choosing a fuel for buses

In Linköping in Sweden, bus emissions dominated local pollution problems. However, the local authority needed to maintain an economically viable bus service. Therefore the annual cost of using each fuel option was compared against the % reduction in NO_x-equivalent emissions. Methane (bio-gas or natural gas) was judged the most cost-effective option, and bio-gas was selected owing to the opposition of environmental campaigners to the extension of a natural gas pipeline.

Have a dialogue with the funding agencies.

At this stage, it is essential to start talking to the funding agencies (if they have not already been involved in assessing city transport solutions and project objectives). In the past, application processes that approve or disapprove a bid in its entirety have put off some entrepreneurs from making proposals. The lesson for bidders is not to give up prematurely, and to seek a dialogue with the funding managers. Similarly, some cities have been deterred from bidding for EU funds because they perceive the process to be complex and costly and the outcome too uncertain. In this case, an experienced consultant may be used to prepare the bid.

Assessment of technology options

One essential element for any clean vehicle project is the assessment of the technological alternatives (including advanced conventional fuelled vehicles). Many projects have found it useful to compile the following information:

- an introduction to each of the available alternatives;
- comparison of emissions performance (particularly for NO_x and particulate matter, which have been associated with the most significant air quality problems and health impacts, and for CO_2);
- summary of vehicle, fuel and infrastructure costs;
- operational implications (e.g. refuelling, maintenance);
- availability and established uses of alternative-fuelled vehicles, and the current status of field trials elsewhere;
- expectations of future technical developments;
- future evolution of emissions and air quality legislation relevant to the environmental objectives of the project;
- details of funding support programmes.

An up-to-date assessment of vehicle options is needed for every project. Advances in gasoline and diesel technologies should not be overlooked.

The emissions performance, prices and taxation of fuels and technologies are continually changing. This is true for both conventional and alternative fuels. For example, ultra low sulphur diesel using exhaust after-treatment systems are seen as cost-effective in reducing some emissions today, but by 2005 hybrid-electric bus technology may be more cost-effective *from a Government perspective*. (Whether they will be price-competitive *for local actors* under market conditions is a separate question.) The cost of compliance with new tighter emissions standards may well vary between technologies, changing their price competitiveness. An up-to-date assessment of costs and benefits of the options is therefore needed at the start of every project.

Example: LPG versus CNG buses

Perceptions of the relative merits of LPG and CNG vary between Member States, depending on the national experience of using each fuel.

In Chester in the UK, the clinching factor in choosing LPG was the practical issue of acquiring refuelling facilities. There was no public access CNG facility in Chester, and the prospect for obtaining early planning consent seemed uncertain. An LPG tank could be obtained easily and the planning consent was known to be relatively straightforward. Also, earlier CNG bus projects in the UK had had some teething troubles with prototype vehicles, and Chester required a reliable "production status" vehicle.

In general, the deregulated UK bus sector is dominated by commercial considerations, which means that low fuel and infrastructure costs have favoured LPG. Also, the presence of many smaller fleets removes some of the opportunities for economies of scale that may reduce unit costs for CNG.

In contrast, the French gas bus programme chose CNG because the national gas supplier launched a subsidiary company dedicated to making CNG available for vehicle fleet applications, and because three major bus manufacturers brought new CNG bus designs onto the market at that time.

Factors determining the choice of propulsion system

The key arguments determining the choice of new propulsion systems that have proved important in some cities are:

- the environmental image of alternative fuels relative to diesel, and the perceived impact on public acceptance (of the project, of public transport, of traffic management measures etc.);
- the actual emissions performance with specific fuels, either at the vehicle tailpipe or over the fuel life cycle (relative to the problems to be addressed);
- the cost-effectiveness of current and future alternative vehicle technologies in reducing NO_x-equivalent emissions;
- the level of noise emissions and the benefits for vehicle operations in sensitive areas (such as night-time deliveries);
- the availability of a technology "off-the-shelf" with good supplier support;
- the track record of technology performance for similar applications in other cities (with nearby examples of success being influential);
- the match between the technology and operational requirements (e.g. range, ease and speed of refuelling, ability to climb hills, performance in cold weather);
- acceptable economics, either competitive with the conventional alternative, or offering benefits that justify a limited cost premium;
- availability, size and cost of refuelling infrastructure, and the regulatory hurdles to install new infrastructure;
- willingness of vehicle and fuel suppliers to support the initiative;

- benefits to local and national industry.

More subjective and political considerations that have significantly influenced the technology options in some cities are:

- a top-down requirement for a spread of technologies to be tested within a large programme;
- a political desire not to use a conventional fuel;
- the availability of subsidies for specific technologies;
- the front-runner status of a particular technology.

In practice, the selection process often starts with a specific technology being seen as a front-runner. Justification or elimination of the front-runner is then sought. Front-runner status can result from:

- a preliminary perception of the most important selection criteria for this city/project and the best technology in meeting these criteria (prior to detailed analysis);
- political will to change fuels;
- previous experiences of the project champion;
- a manufacturer announcing a new product;
- the feasibility of getting the project launched with a certain technology, within the political and budgetary constraints and time horizons for a particular city.

Sources of information

Useful sources of information for the assessment of options include:

- Government, European Commission, International Energy Agency and other publications on the comparative assessment of fuels;
- reports from previous demonstration projects, available on the Web, through city networks or personal contacts;
- lobby groups for specific fuels, such as the European Natural Gas Vehicle Association and the European Electric Road Vehicle Association;
- major EU testing organisations such as TNO;
- vehicle and fuel suppliers.

A list of helpful Web sites is given in the Reference section at the end of these Guidelines. For information on other projects, direct contact or visits will probably give the most useful results, as this can uncover detailed information not found in written reports and allows outside experiences to be related to the local situation.

Look at the results of recent similar projects.

It is worth noting that information on the alternative technologies may well be incomplete. For example, the economics of vehicle operations are very sensitive to the local context. Vehicle emissions are sensitive to the particular traffic conditions and duties of the local application. Technologies are developing rapidly, for both conventional and alternative fuels, such that published results may not reflect future performance. For this reason, the most reliable evidence is likely to be the results of recent projects in other cities that are similar to the option of interest.

Summary of good practice

Good practice

Recommended good practice in assessing the main options for the demonstration project is as follows:

- Review the alternative vehicle technologies and related transport concepts, and see which provide the best match with the project objectives.
- Assess the local conditions that may require specific actions to be taken, such as the introduction of new policy measures.
- Talk to the funding agencies.
- Make a first assessment of risks inherent in the project.
- Check that the scale and scope of the project should be sufficient to allow key outcomes such as modal shift to be measured.

Step 6: Define the preliminary design and assess user needs

When a preferred option has been selected for the project, a preliminary design of the project implementation can be prepared. This will be followed by an initial evaluation of the expected impacts of the project using this design (in Step 7). In practice, Steps 5 and 6 may have a considerable overlap.

The preliminary design is a functional specification for the project, based on the project objectives and the characteristics of the proposed site, and also reflecting stakeholder requirements. It should identify the essential inputs to the project and thereby allow the viability and value of the project to be evaluated.

Design specification

The main elements of the functional specification are:

- number of vehicles;
- choice of vehicle/fuel technology, and a provisional identification of supplier options and vehicle availability;
- choice of transport application to be tested;
- choice of site characteristics and site location (although the latter may come later in some projects);
- identification of user groups and needs to be targeted;
- definition of supporting non-technical measures;
- definition of infrastructure requirements and conformity with planning/safety regulations;
- definition of implementation requirements (such as training);
- definition of communications and marketing strategies;
- definition of an outline evaluation strategy;
- identification of what will be done and by whom;
- estimation of costs, time and resource needs;
- identification of main funding sources;
- identification of main resource inputs, such as project management and evaluation skills and partnering arrangements.

Discussion of the preliminary design forms one focus of the consensus-building process with stakeholders, including user representatives. It helps them to see how they might be affected and where they can contribute, and provides a verification of the adequacy of the design.

Programme requirements for evaluation

The design and the evaluation strategy will need to take account of any top-down requirements of national or European funding bodies. These may dictate that certain indicators are measured so that comparison can be made between the results of different projects. It is worthwhile to study any prescribed formats for funding bids at an early stage, and to discuss with the funding agency what is really needed. (This includes both the requirements for documented information, and the broader requirements of the programme for e.g. stakeholder participation and project content.) An outline proposal often forms a good basis for a no-commitment discussion.

A decision is needed on whether it is planned to end the project after a fixed duration. A time limit may be advisable, since prototype technologies seldom have the reliability and quality of a commercialised well-proven product. The inevitable teething troubles with an innovative technology may eventually create a negative image among users and decision-makers. Therefore the strategy for a transition to a next-generation technology or service should be addressed.

User needs

For the preliminary design (and subsequent detailed design), potential users must be characterised so that the project can be oriented to meeting well-defined needs. Some aspects of this analysis may already have been conducted in assessing transport solutions more generally (in Step 2). Users may include buyers/users of private vehicles, fleet operators, transport service providers and users.

Each type of user has their own set of considerations in deciding on the purchase and/or use of a new transport option. Some general considerations, the importance of which may vary across the users, include:

- vehicle purchase cost;
- fuel and maintenance cost;
- taxes and incentives;
- convenience of use, including refuelling;
- utility relative to current options;
- (public) image;
- emissions and energy consumption;
- compliance with regulations.

Leading-edge and average users

Within each category of user, a distinction should be drawn between *leading-edge* and *average* users. Leading-edge users may be more willing to accept certain disbenefits (e.g. in terms of cost and risk) in return for aspects of the innovation that they value highly (such as low emissions and intrinsic newness). This is important for *radical* transport solutions, where it can be difficult to attract average users. Leading-edge users may be therefore be targeted in a demonstration project. This can allow the transport solution to go up the learning curve and reduce costs via economies of scale, with a view to attracting larger groups of average users at a later stage.

More specifically, users can be categorised according to different trip purposes, origins and destinations, and socio-demographic characteristics such as age and car ownership. Within budgetary and time constraints, the more detailed the information the better the prospects for an effective project. This is particularly true when a new transport concept is being demonstrated, such as self-drive car rental fleets where the user needs are uncertain. In contrast, the substitution of vehicles on well-established services such as park-and-ride and waste collection requires much less learning about users.

User acceptance

A second function of user-needs analysis is the assessment of user acceptance and support for the project. Acceptance is a key element in the success and marketability of any proposed innovation. One aspect of this is the analysis of the buying behaviour of vehicle owners. This can help the project sponsors and local authorities to identify key promotional measures.

Example: Electric vehicles

In the Mendrisio project, where private citizens were encouraged to buy electric vehicles, group discussions with potential users made it clear that large purchase price subsidies were the decisive buying incentive. In addition, people had concerns over the replacement cost and duration of batteries, vehicle range and technical support for cars. Therefore, subsidies of up to 60% have been offered, but only on cars offered with a three-year guarantee on the batteries. In addition, special attention was paid to the provision of car breakdown, repair and maintenance services.

In the Praxitèle project, the profiles of potential users and non-users were identified through focus group meetings and interviews. The results were used in setting the tariff levels and designing the information campaign.

Projects that focus on establishing commercial viability and market interest are likely to need some initial estimates of prices that users will accept, and the level of demand. This is difficult for innovative transport concepts, but may be a primary interest of the commercial project partners such as vehicle manufacturers.

How do you identify the user needs?

Traditionally, two different approaches to user-needs analysis exist. The first is application-oriented; once an application is chosen, the user-needs analysis investigates what service is required. In the second approach the needs of the end users determine the design of the application.

In clean vehicle projects, the appropriate approach depends on the project objectives. For projects oriented towards technology testing in a current application such as city centre buses, user characteristics are generally understood, and the user-needs survey will feed into technical considerations such as the selection of a low-floor design. For innovative projects, the second approach is recommended, since the user needs may impact on major decisions such as site selection and the transport concept to be piloted. Indeed, the match between the project and the user needs becomes a major criterion for the go/no-go decision on the preliminary design in this case.

Once the groups of users have been identified, traditional user-needs analysis techniques can be used. Input can be provided through interviews or questionnaires, focus groups, surveys, group discussions or information sessions. However, user needs should not be seen as static. They may be changing quite dramatically, e.g. in response to changing patterns of work and childcare, and such dynamism needs to be probed. Experience with new transport solutions can also change behaviour, as people adapt to e.g. the short range of electric vehicles.

Open-ended techniques as an interactive Web site, e-mail, a post box and a hotline, where comments and suggestions can be received, also have a role to play. They can be useful as an ongoing means of assessing public acceptance throughout the project life. The feedback is helpful for refining the exploitation strategy established at the start of the project.

Assessment of innovative transport solutions

It must be remembered that user surveys may not be reliable in assessing demand for *innovative* transport solutions, since the users have little feel for the changes in behaviour that may be involved. In such cases, it is worth trying to distinguish the survey results for average users versus leading edge users (that may be more willing to participate in an experimental project). It is also worth *trying* to present the solutions in an understandable, transparent manner that can be appreciated by the vast majority of users. Learning about user needs may be an explicit objective for this type of project.

Things get more complicated when a project aims to explore options to *change* user behaviour. In this case, the idea is not to adapt the transport solution to user needs but, rather, to explore to what extent users are prepared to adapt to the solution. It is still important to make a tentative inventory of user needs before the project. This can be compared to their subsequent actual behaviour, and help to identify critical factors that influenced the change.

Example: Electric vehicles

Interviews conducted prior to the Praxitèle demonstration showed that many people found the self-drive rental concept rather complicated because of the number of innovations involved. This made it rather difficult to design the project to meet the (uncertain) demand. However, experience showed that once the vehicles were available, people adapted quickly to the way of using them.

In the Swiss large-scale EV project (not so much at the Mendrisio test site, but in other parts of Switzerland), EVs were typically acquired as the second household vehicle. In actual use, though, many drivers developed a preference to drive the EV rather than their conventional vehicle. To satisfy this, they developed a more careful planning of trips and a more critical evaluation of their travel needs.

Summary of good practice

Good practice

Recommended good practice in defining the preliminary design of the project is as follows:

- Systematically cover all the design aspects needed for the functional specification of the project.
- Discuss this preliminary design with the stakeholders and funding agencies.
- Assess user needs for the transport solution and user acceptance of changes in behaviour. Distinguish various types of user, including leading edge versus average users where appropriate. Determine whether leading edge users should be targeted.
- Be clear to what extent user needs should shape the project or to what extent the objective is to change and measure user behaviour.
- Set up channels for ongoing user feedback to the project.

Step 7: Make the initial evaluation of the proposed project

Once the preliminary design has been developed, the feasibility of reaching the project objectives with the chosen design has to be assessed. This first phase of evaluation is a safeguard against using further time and resources ineffectively and inefficiently.

For example, if the project aims at local environmental benefits, it is worth modelling the impact it will have on emissions and air quality (either immediately or when the piloted technology has been introduced at full scale).

Evaluation goals

Sub-goals of the initial evaluation are:

- to provide a simple overall evaluation, in mostly qualitative terms, of the project or alternative projects and sites;
- to determine whether the preliminary design and planned evaluation work should be adequate, by the end of the project, to show *unambiguously* whether or not the project has achieved its objectives;
- to check whether the strategy or business plan for implementation opportunities after the pilot phase looks viable;
- to assess whether the current design will be attractive to external funding agencies;
- to identify key risks and what can be done about them;
- to identify whether an appropriate set of stakeholders is involved and committed to the project;
- to select between any major alternative approaches in the project: technical, methodological or organisational;
- to decide whether the project should continue into the detailed design phase.

Example: Bus projects

If a project works with proven technology and the objective is to explore user acceptance of new technology buses in connection with a park and ride facility, it is not a priority to have the bus supplier represented on the project team. If the bus technology is not proven, however, 'deep commitment' of the supplier is needed to ensure that any technical problems will be immediately solved. If in such a case, the supplier is geographically remote or shows little enthusiasm, the initial evaluation could reveal this as a high risk factor and could be a reason to modify the project considerably.

For example, in Bologna, the co-operation of the Italian developer of a new hybrid bus was critical to project success.

Checking the evaluation strategy

The preliminary design (Step 6) will have developed the framework of an evaluation plan (or evaluation strategy) for the remainder of the project, identifying the required types of measurement, data collection procedures and evaluation methods. This must have been done in sufficient detail to allow the *feasibility* of the desired evaluation to be checked in Step 7.

The initial evaluation can be used in marketing the project as well as for decision making. For example, a well-publicised study of the mobility and environmental benefits of the transport system to be demonstrated can show the public and the media the value of the project. In this context, providing evidence of a long-term market potential for the targeted transport solution can increase the justification for the project.

Project risk management: initial evaluation stage

Once the initial project definition has been completed, it is essential to identify major project risks. These are risks inherent in the project that would make it not viable in its present form.

This will be the first in-depth assessment of risk, since there is now a defined design "on the table". Key issues include:

- What are the risks to each element of the project?
- Which are the most important in terms of the potential effect on cost, time and performance?
- What plans need to be developed in the detailed design phase in order to manage risk?
- Is the residual risk (assuming those management actions) acceptable?

A simple quantitative assessment should be made of the likelihood and consequences of all the significant risks. These estimates are combined to derive a total risk score for the project, and the sensitivity to particular factors can then be analysed. This can be done on paper, in a spreadsheet, or using off-the-shelf software for risk modelling.

All significant risks should be identified and estimated.

This assessment feeds into the decision on whether to go ahead with the project. It also provides a serious forum in which to discuss potential major project changes before significant expense and effort is committed. The outcome will inform the detailed project design process, and should also confirm or challenge the current estimates for time and budget.

It is advisable to give a range of project partners and stakeholders an opportunity to express their views and any concerns. This can reveal new sources of risk, and also helps to develop some consensus on the likely pressure points in the project. Plans can then be made to ward off problems and resolve conflicts early.

The range of project partners and stakeholders may have to be reconsidered as well at this stage. It may be useful to take additional ones on board or to evict "troublemakers".

Project risk factors

Important items to be investigated in determining project feasibility and project risk are:

- the dependence on the enthusiasm of the project champion – in the absence of "succession planning", the departure of the champion can effectively kill the project;
- the costs of vehicles, refuelling and other infrastructure;
- the economics of vehicle operation (particularly the expected fuel use and costs);

- the availability of funding and subsidies;
- the availability of critical management resources, such as a strong project manager, an enthusiastic host organisation and skilled staff;
- the availability of a test site and the required infrastructure (e.g. for refuelling);
- the availability of suitable vehicles, and the feasibility of securing government approval for them to run on national roads (homologation);
- the commitment of crucial stakeholders, such as fuel suppliers, vehicle suppliers and the service network;
- local and higher-level political support;
- acceptance by leading edge and average users;
- possible and likely sources of opposition;
- the possible benefits and threats for partners and stakeholders (either related to the project directly or when implemented on a large scale);
- the potential for changes in fuel taxation, affecting vehicle economics;
- the potential for unanticipated technical problems, especially performance (e.g. range and reliability) being below expectations.

Environmental management

Also at this stage, good practice in environmental management calls for the potential environmental impacts and risks *of the project* to be evaluated. (This is distinct from the estimation of the environmental benefits of the transport solution being investigated.) The evaluation should include the initial definition of management actions to minimise harmful effects and comply with environmental legislation. Issues that may be significant include:

- vehicle exhaust emissions, noise, energy use, raw materials, and the use of non-renewable resources;
- homologation (regulatory approval) of vehicles to use the national road network;
- the temporary impacts of building new road infrastructure, such as increased noise;
- the environmental risks of new refuelling infrastructure.

Summary of good practice

Good practice

Recommended good practice in making the initial evaluation is as follows:

- Estimate whether the design and the planned measurements will allow the project to demonstrate unambiguously whether or not the objectives have been reached.
- Check whether the strategy for exploiting the project results looks realistic.
- Systematically assess the project feasibility and all the risk factors, including its environmental acceptability.

Step 8: Refine the objectives and preliminary design

The initial evaluation and risk assessment may lead to some modifications to the project objectives and preliminary design. For example, the work on the evaluation strategy may suggest that the current design will not yield measurable results to prove or disprove certain hypotheses that are central to the project objectives. Project partners may lack the expertise or commitment to tackle possible problems relating to critical risks. In such cases, either the design must be changed or a less ambitious or more focused set of objectives agreed with stakeholders.

Make sure the design will meet the stated project objectives.

A cross-check is also needed between the objectives and the identified stakeholder needs. Where these needs are wider than the objectives, the project design might be adjusted to accommodate the additional needs within the available budget. Where the stated stakeholder needs are narrower than the initial objectives, it is important to check with stakeholders:

- whether the scope of the project is too broad or unrealistic, or
- whether the additional objectives add value (e.g. if there are innovative elements that are beyond the perspective of the average user).

Example: Switching between alternative transport solutions

With over one million inhabitants, Dublin has long-cherished the ambition of implementing a light rail system. At the start of the CENTAUR project, the prospects for a first phase of light rail were quite promising.

Dublin Bus put forward a package of measures to re-organise bus lines around the planned light rail infrastructure, including continued introduction of a Quality Bus Corridor concept that had been successfully tested in a previous project.

When the light rail plans encountered institutional difficulties that could not be resolved within the lifetime of the CENTAUR project, the demonstration of Quality Bus Corridors was intensified. A new fleet of EURO 2 emission-compliant double-decker buses was used along a corridor with over 7km of continuous bus lane. A notable shift from car to bus usage was recorded – making the corridor one of the most effective energy-saving measures demonstrated in the CENTAUR project.

After refining the objectives and modifying the project design, the assessments discussed above under Steps 5-7 should be checked again.

Good practice

Summary of good practice

Recommended good practice in refining the project design is as follows:

- Assess potential discrepancies between the project design, the objectives and the user needs.
- If needed, adjust the objectives and/or design and repeat the checks and evaluations in Steps 5-7 of these Guidelines.

Step 9: Make a go/no-go decision

The next step is to make a go/no-go decision on whether to proceed to detailed design of this specific project proposal.

Project-level decision criteria

The main decision criteria for local decision-makers to consider when deciding whether or not to go ahead with a project are listed below. These will need to be revisited at later stages of the project lifecycle as further information becomes available or circumstances change (particularly after the detailed design phase has been completed):

- Have you defined an appropriate set of project objectives (relevant to the defined problem and the proposed exploitation of the project) that enjoys adequate stakeholder consensus?
- Does the preliminary design match the objectives? Does it satisfy user needs?
- Have you specified feasible measurements and evaluations that would show whether or not the results/impacts of the project have satisfied the objectives?
- Is the cost of the preferred option acceptable with respect to the benefits and the alternatives?
- Is the project big enough to reach the targeted outcomes (e.g. measurable modal shift) and to support fully-fledged project management, evaluation and communication activities?
- Is the environmental benefit from the project or subsequent full-scale application adequately high (e.g. to meet air quality or greenhouse gas targets)?
- Do the likely available funds satisfy the budgetary requirements?
- Are the likely available test sites suitable for the purpose?
- Is the policy support adequate (measures in place or promised)?
- Does real life experimentation bring added value relative to the alternatives (do nothing, paper studies, non-technical measures, full-scale implementation)?
- Can you handle the major risks by effective project design and management?
- Are the residual risks acceptable (such as uncertainty over actual benefits, adverse side effects, user acceptance and technical performance)?
- Are there any critical barriers (e.g. public and stakeholder opposition, legal/regulatory and institutional barriers)?
- Is stakeholder commitment sufficient to tackle critical risks?
- Is there a credible strategy for exploiting the project results?

External funding is often the key factor without which a project cannot proceed, given the current cost premium for purchasing alternative-fuelled vehicles and the limited availability of refuelling infrastructure.

External funding can be the critical criterion.

Programme-level decision criteria

Additional decision criteria can be defined from a national/European programme perspective:

- Does this project fit with the portfolio of fuels, vehicles, transport applications and concepts being targeted by the programme strategy?
- Does this project offer added value relative to other projects, and is there a clear strategy for realising this added value e.g. through a co-ordinated evaluation strategy?
- Do the project objectives match higher-level policy objectives?
- Does the project contribute effectively in changing the vehicle market and the mobility behaviour of users e.g. through co-ordinated vehicle purchasing and wide dissemination?
- Will the project assess the transferability of the results and thus produce an evaluation that is useful to other cities?

Example: Selection criteria from a national perspective

In the opinion of the Swiss Federal Energy Office, Mendrisio was particularly successful in demonstrating political and economic support for their EV fleet test proposal. All 21 municipalities of the region supported Mendrisio's application. The garage trade and vehicle dealers played a central role right from the start, and two motorists' organisations spoke out in favour of the test. Furthermore, numerous companies and private individuals signed declarations of intent to purchase a test vehicle. A detailed budget and proposals for short term support measures were other important criteria for the selection of Mendrisio.

Justification for paying a vehicle cost premium

One critical issue in the go/no-go decision may be the acceptability of paying a cost premium for cleaner vehicles. The following arguments have been used in the past to justify such a premium:

- *Private operator* – the project has major public relations and political benefits, therefore the marketing budget should be used to pay the marginal cost.
- *Private operator* – the vehicle is economic over its lifetime (with reduced fuel costs offsetting higher vehicle purchase costs), according to a payback or discounted cash flow assessment.
- *Private operator* – the project is part of a longer-term strategy to protect business operations, e.g. as a contingency against local policies to restrict city centre access to cleaner vehicles.
- *Specific fleets* – innovative vehicles provide a better fit with demanding operational requirements (such as stop-start driving for postal and airport services).
- *Local authority* – the cost premium is justified by the perceived "public benefit" of improving air quality and promoting public transport. (For example, in the UK, this may fit with the duty of local authorities to secure "Best Value" when contracting for services such as public transport.) The evaluation may be primarily political, or based on scientific criteria such as cost-benefit analysis (weighing vehicle costs against the monetary value of e.g. reduced health impacts).

- *Large employers with company fleets (e.g. hospitals)* – the income from staff permits for car parking pays for transport improvements such as cleaner-fuelled company vehicles. This hypothecation of revenues is important in increasing the acceptance of paying for parking.

Summary of good practice

Good practice

Recommended good practice in making the go/no-go decision is as follows:

- Check the proposal against the list of main decision criteria at the local level.
- Assess the proposal against the decision criteria that will be applied by funding agencies, such as national and European programmes.
- Identify the potential long-term benefits of the transport solution for various stakeholders that can be cited to make the cost premium for cleaner vehicles acceptable.

Results of the set-up phase

Having gone through the various Steps discussed above, the results of the set-up phase will be:

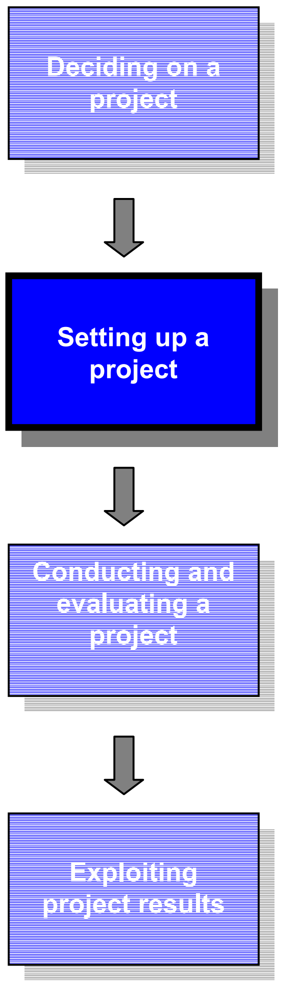
- identification of user needs (perhaps requiring further investigation in the design phase);
- identification of (likely) funding sources and the requirements of fund managers;
- refined objectives (reflecting stakeholder and user needs);
- coherence between the project objectives and national/EU policy goals and long-term strategies (particularly where Government funding is sought);
- a preliminary project design, giving the functional specification of the project;
- outline strategy for data collection and project evaluation;
- development of consensus with stakeholders and commitment from crucial stakeholders;
- creation of ongoing channels of communication with stakeholders and end-users;
- initial evaluation of the preliminary design;
- initial risk assessment and risk management plan;
- initial strategy or business plan for the longer-term exploitation and follow-up to the project;
- go/no-go decision on whether to proceed to detailed design work.

Section 3.
Setting up a project

3.1 What are the critical aspects of project design?

3.2 How should the site be selected?

3.3 What are the critical aspects of evaluation?



In this Section:

- What should I consider in the design of the project?
- How should I analyse risks and evaluate the design?

3.1 What are the critical aspects of project design?

The main issues

What should I consider in designing the project, in terms of content and process? How will the detailed objectives affect the design?

What should I do to manage the risks and evaluate the design?

The design phase of the project lifecycle

After the go/no-go decision on the project concept (objectives, preliminary design etc.), the next activity within the project lifecycle is to develop the detailed design, leading through to the go/no-go decision on project implementation. This Section identifies good practice for this process.

Sections 3.2 and 3.3 cover site selection and project evaluation in more detail.

Four main elements can be distinguished within the design phase:

- Preparing the detailed design
- Selecting the site (if not already defined as part of the project concept) – see Section 3.2
- Evaluating the design – see also Section 3.3
- Taking the go/no-go decision to run the project.

The design process

The detailed design of the project starts from the preliminary design, the initial evaluation and the decision to take forward the planning of the project. The preliminary design stage established an overall concept for the project with a basic set of functional specifications. The project team now has to convert that concept to the definition of hardware and software items, time and resource plans, management structures and responsibilities, policy actions and communications tasks, and data collection and evaluation plans.

The design must be developed to be consistent with (or driven by) the project objectives and user requirements. In addition, it should have general acceptance from stakeholders, including end-users. The people who will implement the project should be involved as early as possible.

Example: The link between objectives and project design

In 1992, the Swiss Federal Energy Office launched an EV demonstration programme. The objective was a total of 200,000 lightweight electric vehicles on the road by 2010. That corresponds to about 8% of the number of cars on Swiss roads today. Therefore a critical density of 8% EV's in the vehicle fleet was a principal feature of the project design for the Mendrisio test (i.e. around 350 vehicles).

In Linköping, the city authority wanted eventually to replace *all* diesel buses with gas buses. This meant that the demonstration project had to show the feasibility of gas supply covering the whole fleet use, and not just a limited number of vehicles.

This is the point in the project lifecycle when *all* aspects of the project and their implications must be carefully reviewed in order to create a well-focused and effective scheme. The importance of a complete design of the transport solution is also related to the complexity of the urban transport system and its various actors. It is extremely important to take account of the interdependencies between the components of the solution, such as the effect of car restraint measures in increasing patronage and improving the profitability of new bus services

The analysis of user needs and stakeholder requirements should have been developed in the preceding lifecycle stage – see Section 2.2. However, depending on resource availability, it may be appropriate to obtain a more detailed assessment of user needs at this stage, in order to clarify certain details of the project design. For example, the Praxitèle project carried out some user surveys just two months before the opening of the car rental service, in order to fine-tune the experimental design.

See Step 6 in Section 2.2.

Stakeholder interaction should continue during the design process to ensure continuing commitment.

Constraints and requirements

All the technical elements of the project must be designed in accordance with the regulatory and other standards in force. Investigation will be needed into planning requirements, safety of refuelling infrastructure and vehicle maintenance operations, and roadworthiness approval for novel and alternative-fuelled vehicles. (This is discussed in more detail in a later sub-section.)

Aesthetic aspects (for example, of vehicles and infrastructure) should be taken into account, within the constraints imposed by functional requirements and economics. In a number of cities, the smart appearance of new alternative-fuelled buses and passenger facilities is perceived to have played a role in increasing bus patronage.

The design stage is generally conducted within a set of financial, legal, political and time constraints that may determine the extent of the project itself. In order to ensure proper design within the defined limits, it is essential to determine from the beginning of the design stage exactly what are the nature and scale of these constraints. These will necessarily differ from project to project. For example, the requirement for an operational service has forced some projects to abandon their original plans for using hybrid vehicles in favour of "off-the-shelf" technologies.

It can be helpful to look at other cities' experiences to pick up ideas for project design. However, you can never transfer one project design into another place. Each site has its specific environment, which requires its own concept.

The design process will need to take account of existing requirements within the host organisation, such as quality assurance procedures (ISO9000), environmental management systems (ISO14000) and project management procedures. This includes adequate documentation, definition of responsibilities, and the specification of mechanisms for checking that the actual work conforms to the agreed design. A safety audit may be required where new fuels and road infrastructure are to be introduced.

The reporting on the design stage must provide the background documentation needed to justify the design in terms of its relationship to the project objectives within the context of budgetary and other constraints.

The content of the design

Technical aspects of the design

The technical design of the project includes details such as:

- project size (number of vehicles, final choice of sites);
- project duration and end-date;
- the specification of the vehicles to be used and the arrangements for vehicle supply;
- vehicle duties and routes;
- the fuel supply and refuelling arrangements;
- vehicle maintenance arrangements;
- training for drivers, maintenance staff etc;
- the specification of other infrastructure such as new bus stops and innovative ticketing and information systems;
- the specification of associated public works, such as bus lanes and zone access control points;
- data measurement methods, such as vehicle emissions tests and vehicle data loggers.

Non-technical aspects of the design

The project design also includes non-technical aspects such as:

- time, cost, resource plans (including contingency arrangements and allowance for price inflation);
- specification of supporting policy measures and the process for introducing them;
- communications and marketing strategies, for both stakeholders and different user groups;
- data collection and evaluation plans;
- definition of management structures, staff and responsibilities;
- progress review and reporting mechanisms;
- milestones, decision points and decision criteria;
- risk management and environmental management procedures.

If significant infrastructure building and road works are needed as part of the project, a thorough assessment of the costs to move underground services (such as gas pipelines and high voltage electric cables) must be made. UK experience has shown that these costs can form a significant proportion of the total project costs.

On critical aspect of the design is the definition of milestones when decisions will be taken on the exploitation of project results. This must be tied into the evaluation plan. Generally these decisions will need to be taken before the final end of the project.

Design of data collection

The design of the data gathering activities must take account of the data needs established in the evaluation strategy – see Section 3.3. For example, the design should specify the variables to be measured, the best methods of data collection and the sample size. Data sources must be chosen, i.e. instrumentation, observation, surveys and/or existing records.

Four types of data sources:
1. instrumentation;
2. observation;
3. surveys;
4. existing records.

However, budget constraints may require compromises. Therefore it is necessary to consider the cost and accuracy of each option for data gathering. Options can then be assessed in a trade-off between (a) their demands on the total evaluation budget and (b) their expected importance in proving the attainment of project objectives.

Site characteristics must be considered because they influence the local impacts of the project with consequent implications for transferability of findings to other cities. Therefore the design of the data collection must also ensure that the most significant external circumstances will be recorded before and during the project, especially when multi-site comparison is to take place.

In most clean vehicle projects, data collection for the evaluation of environmental impacts will be required to meet the project objectives. There are many issues here, which are discussed in some detail in Section 3.3.

See Section 3.3 on evaluation.

Several projects have found it useful to define a data manager. This person should be involved throughout the design process.

Project duration

A long duration is very important for a project aimed at introducing an innovative transport solution and a change in patterns of mobility. This reflects the slow rate of change in the behaviour of buyers and travellers, and the conservatism of institutional structures. At the same time, the vehicle dealers and suppliers need long-term policy perspectives in order to adapt their business plans.

A long project duration is needed to observe changes in behaviour.

As a rule of thumb, projects of the following duration can be recommended:

- 1+ years for technology performance testing;
- 2+ years for demonstrating new mobility solutions.

If other city projects or policy decisions hinge on the outcome of a particular technology test, then a more limited duration with intense evaluation effort may be appropriate. For example, a project aimed at technology testing may require only a few months to get representative data on vehicle performance. However, if unambiguous evidence of real-life operations and vehicle reliability is required, then the time scale must be extended.

One year can usually be recommended as the *minimum* duration for on-the-road demonstration.

It should be noted that drivers and workshop staff are likely to take several months to get the best performance from a new vehicle, and data will need to be collected for some months *after* the settling-in period in order to get statistically reliable results. Therefore one year can be recommended as the minimum duration for on-the-road demonstration in most projects. Experience also suggests that, for substantial projects with *new* technologies, an initial 3–12 month learning phase with one to three vehicles is beneficial, before the demonstration with 10 or more vehicles begins.

An extended duration will be required where long-term effects such as differences in summer-time and winter-time performance could be significant, or where gradual changes in user behaviour and traffic patterns need to be assessed. Again, if the aim of the project is to convince *external* organisations of the viability and benefits of a new transport solution, performance over perhaps two years should be demonstrated. This allows the operating costs and maintenance requirements to be established with some certainty.

Project size at a single site

The choice of the number of vehicles and the geographic area included at a single site depends on several criteria:

- A single vehicle may be sufficient to show stakeholders that a certain technology is viable. For example, a local authority could operate a single LPG bus for a few months to demonstrate to local bus operators that their next tenders for bus service contracts should include LPG as an option.
- 3–10 vehicles may be enough to provide statistically adequate information on the operational and environmental characteristics of a selected vehicle model.
- If the economic viability of a new transport service is to be tested, 20–50 vehicles may be needed in order to spread the cost of associated infrastructure investments such as refuelling systems.
- Several hundred vehicles may be needed to investigate the effects of a new transport solution (such as rental vehicles) on the mobility patterns in a whole town.

Example: Swiss large-scale EV fleet test in Mendrisio

The Mendrisio region proved to be too small as a project site because it covers only part of the geographic territory of most of the car dealers. As a result, the dealers couldn't benefit cost-effectively from their marketing of EVs. Also, the charging stations installed in the region could not be used in an optimal way. Nevertheless, the smaller a test area the easier it is to manage the project.

Example: Hybrid buses in Bologna

A radial route was selected for testing hybrid buses. This allowed electric-only operation to be demonstrated in the city centre, and recharging to take place on other parts of the route. The specific route gave sufficient distance in diesel mode to ensure that the batteries always had sufficient charge without the need for night-time recharging.

Design for multi-site projects

The integration of multiple sites into a single project or co-ordinated programme is important where a main objective is to develop site-independent findings. For example, national and European programmes may require an element of evaluation that is co-ordinated between sites. This allows the effects of site characteristics to be investigated, where the same transport solution is tested at more than one location. The effects of supporting policies can be assessed in the same way, where different policy packages are implemented in similar cities. This allows general conclusions to be passed on for the benefit of other cities and EU Member States.

Example: EC CENTAUR project

The CENTAUR project has brought together nine cities from across Europe. Vehicle, fuel, infrastructure and equipment innovations have been tested in various combinations. The comparison between city results has allowed general conclusions to be drawn on the most effective ways of reducing energy consumption and emissions. A common method of evaluating these effects was adopted at all test sites.

An individual project needs to consider:

- the requirements of national and European funding agencies for common evaluation frameworks;
- the added value of using more than one site, such as two or more bus routes within a city;
- the added value of voluntary partnering with other cities;
- the requirements for similarities and differences between sites.

Avoid too many differences between linked sites.

One general rule for inter-site comparison is to avoid too many changes between sites. Variables include city characteristics such as topography and demographics, fuel choice, vehicle technology, policy support measures, and even differences in the travel behaviour of passengers on different bus routes. If several variables are changed simultaneously, it will be difficult to extract robust conclusions from the inter-site comparison. For instance, if several technical characteristics are changed between vehicles, it can be difficult to identify the aspects that influence performance the most.

In particular, fuel consumption and vehicle emissions are strongly dependent on the operating environment. Results can vary significantly with topography and traffic conditions.

See Section 3.3 on evaluation.

The main mechanism for inter-site co-ordination is usually the evaluation strategy. This is discussed further in Section 3.3. Experience shows that getting consistent information from multiple sites can become difficult during the course of a project. Some cities inevitably focus on their own results and contribute less to the cross-city evaluation. Good communications are needed to avoid this.

Marketing strategies

Marketing methods:
- vehicle advertising;
- test drives;
- media articles;
- launch events;
- presentations.

Marketing of the project should be aimed at all stakeholder groups, with an emphasis on the vehicle purchasers and users. Common methods are:

- on-vehicle advertising, such as painting the vehicle with a distinctive livery and providing information leaflets for bus passengers;
- making vehicles available for test drives and rental;
- media articles and press releases;
- launch events;
- seminars and demonstration workshops;
- providing materials for projects in local schools.

Providing vehicles for public events wins support, but can clash with service operations.

Local exhibitions and test drives of the technology, a network of public recharging/refuelling stations (with a mainly psychological effect) and local dealer support have been found to be highly effective. However, projects have also experienced a lot of problems making vehicles available for events while maintaining the intended commercial operations.

The services of a professional communicator may be cost-effective, particularly where the project has to attract a wide range of users (such as private car owners) and where one objective of the project is the wider promotion of a new transport service.

Publicity to the general public is particularly important for costly public-funded projects. Dissemination materials should point to good examples of applications and benefits of the technology, and not just the technical details of the local implementation. Early publicity can help to raise awareness and support, but should avoid being over-optimistic.

Example: Self-drive electric cars in Martigny

The local newspaper runs a weekly article on the progress of the project. This has proved influential in encouraging people to register as vehicle users.

Design of supporting measures

Policy actions may be taken at city, European and national levels to support market acceptance of cleaner vehicles and new transport concepts. Measures that are likely to be within the control of the local project stakeholders are:

- investment in complementary aspects of public transport infrastructure, such as new road layouts, traffic control signals, information systems and passenger facilities;
- traffic restraint measures that favour cleaner vehicles, such as Low Emission Zones and parking restrictions;
- subsidies for public transport services using alternative-fuelled vehicles;
- public information campaigns;
- free and extended duration parking for alternative-fuelled vehicles.

Supporting measures:
- infrastructure investment;
- traffic restraint;
- subsidies;
- information;
- parking privileges.

The best approach seems to be a well-balanced mix of information, infrastructure and financing measures. Subsidies on the vehicle purchase price seem highly important (not only in a financial sense but also in a psychological one, improving the confidence in a product by the support of the authorities as a kind of labelling).

Example: Marketing and support measures

Because of the limited performance and the risk of extra costs, the market launch of electric cars requires promotional measures. These measures are aimed at familiarising the public, removing obstacles to the buying decision, limiting the inconveniences and providing support for EV users. In the Mendrisio project, the following were tested:
- purchase price subsidies (the single most important measure);
- publication of news/information in the local newspaper;
- advertising;
- test drives and rentals;
- exemption from motor tax for electric vehicles;
- reduction in the insurance premiums;
- minimum of three years guarantee for batteries;
- free breakdown service;
- provision of a replacement vehicle in cases of breakdown;
- discount on rental vehicles,
- free public recharging stations;
- reserved parking places;
- free and double-time public parking;
- advisory service;
- display of EV's in local events;
- driving lessons.

One of the most effective measures for familiarising the general public with the EV proved to be the test drive. Reports on EV's in the local newspaper, whether about the fleet test in general or about specific events, were also important.

Some new transport solutions may wish to seek legal status (e.g. as a public transport service) in order to qualify for measures such as reserved parking places on the street and the use of reserved bus lanes.

Example: Parking concessions

The CityCar project obtained permission from the local authority in Martigny to mark certain spaces with green lines designed only for parking electric cars. However, such green lines do not have a legal basis in Swiss regulations and are not mentioned in the Highway Code.

Shopkeepers have requested the relaxation of parking restrictions for electric cars in shopping areas. Similarly in Rome and Turin, privileges for electric cars such as free/reserved parking, access to traffic-restricted zones and reserved lanes have been cited as incentives for EV use.

The importance of supporting measures should not be under-estimated.

These supporting measures are not covered in detail in these Guidelines. However, their importance should not be under-estimated. The THERMIE targeted transport projects provide good examples of the integration of cleaner vehicles with non-technical measures for urban transport – see www.thermie-transport.org.

Planning for vehicle procurement

Vehicle choice and operational performance are invariably central to the success of a clean vehicle project. The technology will have been chosen in the preliminary design of the project. Now, at the detailed design stage, choices have to be made concerning the specific vehicles and their use. Issues to be considered include:

Criteria for vehicle selection:

- operational performance;
- vehicle and fuel price;
- supplier motivation;
- funding criteria;
- fuel supply;
- vehicle homologation;
- vehicle availability;
- learning and training;
- servicing;
- operational implications;
- risk-sharing;
- measurement needs.

- *Vehicle performance relative to requirements.* What evidence can the supplier provide of real-life performance under similar operating conditions?
- *Vehicle cost.* Teaming up with other cities to put in a larger order for vehicles may give the market power to negotiate a more competitive price and get a higher priority from the manufacturer in addressing any technical problems (see sub-section below).
- *Benefits to the vehicle manufacturer.* A small project has to compete with many other projects for the interest of the manufacturers. This can be encouraged by offering to supply technical data/experience and good publicity.
- *Meeting the criteria for external funding.* National funding may influence vehicle choice, e.g. where the level of subsidy is linked to the emissions performance.
- *Securing a retail supply of the fuel.* It may be helpful to talk to both the energy suppliers and the local fuel retailers. Safety and planning regulations need to be investigated where the project is responsible for installing its own refuelling infrastructure.
- *Negotiating a price for the fuel.* Gas and electricity usually do not have a standard price for transport applications, and volume-dependent pricing is common. The fuel price may or may not include the price of the refuelling infrastructure. The price may vary significantly over the course of a project, depending on movements in spot prices and tax levels.

- *Securing homologation of innovative vehicles* (i.e. permission to use them on national roads). This has been a source of project delays. Therefore it is important to talk to the vehicle manufacturers and suppliers *early* about securing homologation, and to enlist the co-operation of the national regulatory authority. If necessary, local politicians, vehicle and fuel suppliers should be asked to lobby on behalf of the project.

Seek regulatory approval for innovative vehicles at an early stage.

- *Contingency planning for late delivery of vehicles.* This has been a common problem in demonstration projects. There have been particular problems with electric vehicles, probably due to their greater technological immaturity.

- *Learning and training.* It is ***essential*** to allow time for adapting to new vehicles, and to provide training for drivers and workshop staff. One or two months should be allowed for drivers to adapt to new vehicles before evaluating fuel consumption. (Consumption was found to improve by 10% over this period in French CNG bus trials.) One to two years may be needed for workshop staff to optimise maintenance procedures, as found in both the French CNG bus trials and the Linköping biogas bus project. (Emission results can be quite sensitive to the optimisation of engine tuning, and adaptation to the local composition of a gaseous fuel can be important.) The services of an expert trainer may be needed. These may be available via the vehicle manufacturer, fuel infrastructure supplier, vehicle operators' association or a university. Web sites may also provide useful contacts. Workshop staff may need to learn the safety standards and techniques for handling gas supply systems or high power electrical systems. Project stakeholders may need to organise training for other staff too, such as the fire brigade, vehicle suppliers and road-side breakdown teams.

It is *essential* to allow time for learning and training on new vehicles.

- *Operations management.* To achieve representative results from test vehicles, drivers must be made aware of the need for consistent behaviour. For the drivers to understand what is going on, the person responsible for the operational side of the project within the vehicle fleet needs to have a hands-on role and the respect of the workforce.

- *Servicing.* Swift competent technical backup is vital when working with new technologies. Where the operator uses third-party servicing, the adequacy of support for new technologies needs to be checked in advance. The project manager could ask for a maintenance agreement to be included in the vehicle procurement contract. If the vehicles are supplied from overseas, the local dealer may need to be persuaded to establish an adequate buffer storage of spare parts in the country. Otherwise the project will incur downtime waiting for parts to be delivered from abroad. (This proved to be a problem for the electric vehicle project in Skåne in Sweden.)

Ensure good technical backup.

- *Operational implications.* The vehicle range, location of refuelling stations and the time needed for refuelling may require some changes in vehicle schedules. Parking and refuelling may require some infrastructure changes and planning approvals.

- *Risk-sharing solutions.* Where technologies imply a significant risk of service failure, such as traction batteries in electric vehicles, then some form of leasing arrangement may be used to reduce the risk to the end-user. This may cover a specific component like the battery, or the turnkey provision of a complete service (as in the case of the Le Touc EV shopping shuttle in Toulouse, where the supermarket chain paid a monthly fee to the service provider).

See Section 3.3 on energy and emissions measurement.

- *Defining the measurement systems.* Consideration must be given to how the energy use and emissions performance of the vehicles is to be assessed (if appropriate). Choices include on-vehicle data loggers (although measurement of gaseous fuel flow is problematic), refuelling measurements, and a variety of emissions testing methods (discussed further in Section 3.3).

Example: CNG buses in Southampton

Southampton City Bus acquired 16 CNG buses in the mid-Nineties as part of two demonstration projects. The company's health and safety representative, the gas supplier, the engine supplier and a university designed a special training course for staff. The course provided instruction on the fitting of gas engines, the electrical systems of CNG buses, and the safety and legal responsibilities of managers. In addition, all company staff attended a one-hour video-based general awareness course on CNG engines, safety and refuelling issues.

Example: Fuel use by CNG vehicles

The London Borough of Merton found that the fuel use on its CNG vans and minibuses was initially higher than expected. This resulted from over-revving of the engine by drivers unaccustomed to the low level of engine noise. Driver training solved the problem.

Travel West Midlands experienced 40% higher fuel use on its CNG buses than the vehicle manufacturer predicted. This difference was attributed to the more demanding driving conditions in the UK relative to the Swedish locations where this bus type had previously been used. The unexpected fuel demand changed the economic assessment and incurred operational penalties due to additional refuelling stops.

Example: Driver training for electric vehicles

Projects with electric vehicles have noted that thorough driver training is needed to optimise energy use and maximise the vehicle range on a single charge. Individual driving patterns have a greater influence on energy consumption for EV's than for conventional-fuelled vehicles. Similarly, the conditions for battery charging need to be optimised.

Co-ordinated procurement of vehicles

Co-ordination with similar projects gives the opportunity to combine vehicle orders. This can increase negotiating power for the buyers, and open up attractive economies of scale for manufacturers. The challenge is to agree a common specification between projects that suits a number of different applications. This may be particularly difficult for buses, where cities are accustomed to defining their own specifications.

The following warnings should be noted:

- Some manufacturers (e.g. in the bus sector) do not support all national markets across Europe, so co-ordinated procurement may receive only a limited response and favour the largest suppliers.
- Some manufacturers may have chosen in the past to co-operate with major projects in order to explore specific technological options. They may show less interest in similar projects in the future.

The European Commission's ZEUS project has done some pioneering work on co-ordinated procurement, as described in the following example.

Example: EC ZEUS project

The ZEUS project has procured more than 750 vehicles for demonstration in eight cities across Europe. Co-ordination of procurement between cities with similar requirements reduced the purchase cost of some electric vehicles by 25% relative to buying vehicles singly. The cities also obtained options rights, allowing them or third parties to buy further vehicles at the same price. For example, one agreement covered firm purchases of 127 vehicles and 99 options rights. The cities negotiated favourable contract conditions too, such as:

- supplier commitment to continuity of maintenance support;
- limits on prices of spare parts;
- supplier acceptance of sanctions in case of late delivery.

However, there were logistical difficulties in getting all the cities to agree on a common specification. This is a particular problem for commercial partners that get frustrated by the much slower decision processes of local authority partners.

It might be concluded that co-ordinated procurement is most useful for less-developed technologies where a large order brings significant economies. It is perhaps less beneficial for off-the-shelf technologies, unless the buyer group is fairly homogeneous so that logistical difficulties are minimised.

Co-ordinated procurement is most useful for less-developed vehicle technologies.

Good practice in project management

As part of the design phase, plans should be developed for overall project management, risk management and environmental management.

Project management

See Section 4.1 on project implementation.

Project management aspects include the detailed definition of tasks and responsibilities (see Section 4.1). The plans should be consistent with the project management and Quality Assurance procedures of the host organisation. The ISO9000 standard states requirements for what should be done to manage *processes* influencing the quality of the outcome. In terms of a pilot or demonstration project, the emphasis will be on managing critical aspects of the project to meet the objectives, such as providing unambiguous proof of the environmental benefits of a new transport solution.

Risk management

Once the detailed design of the project has been completed, the risk assessment made on the preliminary design needs to be reviewed and refined.

Risk management objectives:
- identify risks;
- assess size of risks;
- identify risk owners;
- plan the risk management.

This is the second in-depth assessment of risk within the project. The objectives are:

- to identify all risks associated with the project, for all the actors involved;
- to determine the size (likelihood*consequences) and hence priority of each risk;
- to identify the owners of each risk and make appropriate links to contractual expression of the key risks being held by each party;
- to produce a risk management plan. This will be prioritised according to the magnitude of each risk, and each action on the plan will be tied to the risk owner.

At this stage, where budgets and time scales may be committed in contracts and other interfaces with third parties, it is likely that quantitative analysis will be required. The level of refinement of the analysis will depend on the complexity, scale and importance of the project.

It is *essential* at this stage to identify any "showstopper" risks that would call for the project to be abandoned or redesigned, if major wasted expense is to be avoided. Risk severity should be viewed in terms of its effect on project "success" as perceived by *each* of the stakeholders.

An important example of risk sharing is the leasing of batteries for electric vehicles. This transfers the risk of battery failure from the vehicle owner/operator to the technology supplier, and allows the residual market value of the vehicle to be calculated more readily.

Example: Electric vehicles in Skåne

This project leases passenger EV's to private and public organisations. The durability of the first generation NiCd traction batteries was inadequate, requiring exchange after an average distance driven of 16800 km. One of the two major EV suppliers started to offer leasing of the battery separate from the car. After that, consumers stopped buying vehicles from the other supplier.

Common problems and risks

Problems can be *expected* to arise during the implementation of the project. Contingency plans and risk management strategies are therefore essential. Examples of problems include:

- Delays in the planning process for approving new infrastructure (new bus routes, refuelling stations, use of gaseous fuels in vehicle workshops etc.). Involving the local authority as a project partner or part of the stakeholder network is recommended. Specialist safety consultants may need to be employed.
- Late delivery of the vehicles. (***Note: this problem has been reported by many projects.***) Involving the vehicle supplier as a project partner or part of the stakeholder network is recommended. Linking the vehicle purchases of several cities to increase customer power may also help. Using a diversity of vehicle suppliers should be considered.

Late delivery of vehicles has been a common problem.

- Delays in the approval of external funding. Bureaucracy and contractual negotiations have caused problems in scheduling the start of projects that depend on national and European funding. Close co-operation and treating the funding organisation as a stakeholder are recommended.
- The possibility that a vehicle runs out of fuel in operation. Unlike diesel and gasoline, gaseous fuels cannot readily be supplied in the street (although some gas utilities in the USA do have mobile refuelling trucks). Therefore operational duties, refuelling schedules and fuel storage capacities have to be carefully assessed before the vehicles are ordered.
- Teething troubles with individual new technologies (such as in-vehicle direct debit payment systems) and with new forms of integration of technologies. Depending on the complexity and degree of innovation of the technologies, a settling-in period should be scheduled prior to the testing of operations under "market" conditions.
- Changes in key personnel, such as the project champion and professional project manager. The identification of "shadow" staff who can step in as substitutes may be appropriate, or the definition of contingency procedures for the rapid appointment of a successor.

Example: Electric vehicles in Martigny

The CityCar project chose to fit their electric cars with an automatic handbrake. The aim was to overcome the (perceived) greater risk of freewheeling in an electric car, compared to an internal combustion engine car, if the user failed to apply the handbrake manually. However, it became evident that such a system would be technically complex, as it also has to be safe in the event of an electrical failure (i.e. not stopping the car immediately in moving traffic). Risk analysis indicated that such electrical failure could not be ignored in a prototype technology.

Delays in vehicle delivery and in the refinement of the on-board technologies meant that the cars were not ready as planned for the official launch and the early user-testing phase. Nevertheless priority has been placed on overcoming the technical challenges, so that the phase of testing market responses is not disturbed by operational problems.

Environmental management

It is good practice to assess the *direct* environmental impacts of *any* project. This may be required by the Environmental Management System of the host organisation, established under ISO14000. Large projects and national/European programmes should also note that the European Union's Directive 85/337/EEC on Environmental Assessment requires that an environmental impact assessment should be undertaken for all projects within the European Union that might generate significant environmental impacts.

Environmental management requirements can readily be integrated into project management at the design stage. Key elements are:

- Identify what environmental impacts of the project are "significant" and therefore need to be managed.
- Define responsibilities for managing these effects.
- Re-assess the project design to minimise impacts where feasible.

The following aspects should be included in the project plan:

- how environmental performance will be measured, reviewed and improvements implemented;
- procedures to ensure legal compliance and environmental protection;
- staff environmental roles and responsibilities;
- training of staff and contractors (ranging from emergency preparedness to good driving techniques);
- requirements for monitoring of environmental management.

Similar to any task within a project, environmental and risk management need to be defined and scheduled according to their significance.

Ex-ante evaluation of the project design

After the detailed design of the project has been completed, the ex-ante evaluation can proceed. (*Ex-ante – **before** the project implementation.*) The goals of this phase of evaluation are:

- to check that the conclusions from the evaluation of the preliminary design (Section 2.2, Step 7) are still valid,
- to check that the detailed design remains consistent with project objectives (and improve the design where necessary), and
- to set up the baseline for the ex-post evaluation of the project results. (*Ex-post – **after** the project implementation.*)

Goals of the ex-ante evaluation:

- Check the evaluation of the preliminary design.
- Check and refine the detailed design.
- Provide the baseline for the evaluation of project results.

The ex-ante evaluation provides an estimate of the detailed impacts of the project, and requires much more data than was available or necessary for the initial evaluation. The data will be based upon specific new measurements and surveys, available statistical records, supplier data and results from other projects. The data should preferably cover the same variables and impact indicators that will be used in the ex-post evaluation, so that the ex-ante estimations and the ex-post outcomes of the project can eventually be compared. Effectively, this is a classic 'before and after' evaluation. (Section 3.3 discusses the choice of variables and indicators to be used.)

See Section 3.3 on evaluation.

In this phase, it is important to estimate the impacts of the project, in order to answer the question whether implementation of the proposed project design will meet the agreed objectives. For example, effects on vehicle emissions and air quality can be modelled. The estimated results will highlight any areas where the impacts could be less favourable than originally anticipated. The results can trigger modifications of the proposed design and evaluation strategy, or provide the basis for a go/no-go decision on proceeding to project implementation.

Both the technical and socio-economic performance of a project should be evaluated. It is cost-effective to concentrate initially on evaluating those impacts that are central to the project objectives (such as environmental impact or financial viability). This evaluation and any design modifications should be iterated first, and the rest of the evaluation only performed once the design has been fine-tuned.

Concentrate on impacts that are central to the project objectives.

Go/no-go decision criteria

At the end of the ex-ante evaluation, an explicit go/no-go decision should be taken on the detailed design. This should be done in consultation with stakeholders, including funding agencies and politicians. Relevant criteria are:

- Do the defined project objectives still enjoy adequate stakeholder consensus?
- Have feasible and affordable measurements and evaluations been planned that should show whether or not the results/impacts of the project have satisfied the objectives?
- Do the available funds and other resources satisfy the budgetary requirements for project implementation and evaluation?
- Are the selected test sites suitable for the purpose?
- Does the selected project design bring added value relative to the alternatives (do nothing, non-technical measures, alternative project designs, full-scale implementation)?

- Are the risks manageable or acceptable (such as uncertainty over actual benefits, user acceptance, adverse side effects, technical performance and scale-up potential)?
- Are there any critical barriers for which solutions have not yet been found (e.g. public and stakeholder opposition, legal/regulatory and institutional barriers)?
- Is there adequate policy support?

Programme-level decision criteria

These are decision criteria from the local perspective. Additional criteria may be applied from a national/European programme perspective:

- Does this project still fit with the programme strategy?
- Is there a clear strategy for realising the added value of cross-city and cross-project comparison e.g. through a co-ordinated evaluation strategy and co-ordinated vehicle purchasing?
- Will the project contribute effectively to programme goals e.g. through wide dissemination?
- Does the detailed project design still conform to the decision criteria and evaluation decision made when the programme selected the project for support?

Summary of good practice

Good practice

Recommended good practice for preparing the detailed design of the project is as follows:

- Define the financial, legal, political and time constraints at the start of the design process.
- Ensure that the design covers *all* the technical and non-technical aspects of the project that need planning.
- Check that the design (including the data collection plan) is able to achieve the project objectives.
- Check that the design satisfies the requirements of stakeholders and end-users.
- Allow at least one year for testing vehicle technologies, and allow at least two years to demonstrate new mobility solutions that require a change in user behaviour.
- Allow plenty of time for training and adapting to new vehicles.
- Allow adequate time and budget for post-project review and final reporting.
- Where inter-site comparison is intended, avoid too many differences between sites.
- Consider co-ordinated procurement of vehicles, combining orders across several projects/cities, particularly for less-developed technologies.
- Develop a marketing strategy, aimed at all stakeholder groups including end-users and vehicle operators.
- Analyse risks and develop a risk management plan, particularly for common problems such as late delivery of vehicles.
- Assess the detailed design, estimate the expected impacts of the project and take an explicit go/no-go decision.

In this Section:

- What should I consider in selecting the site?
- What could be the influence of related projects?

3.2 How should the site be selected?

The main issues

What should be the content and process of the site selection process?

What is the possible influence of national and European programmes and objectives?

When is the site selected?

See Step 6 in Section 2.2.

Site selection may be part of the preliminary design (see Section 2.2) or part of the detailed design after the initial go-ahead has been given for a pilot project.

From the perspective of a city or fleet operator, the site may be "obvious", for instance if the transport problem to be solved is associated with a specific location (such as a congested or heavily polluted route). On the other hand, if a group of cities are seeking to set up a more ambitious project within a national or European funding programme, they will need to think carefully about how the choice of complementary sites can contribute to achieving the programme objectives.

Site selection from a local perspective

From a local perspective, the choice of sites is likely to be limited. Nevertheless there are still options such as the choice of bus/delivery route or vehicle depot that can impact on the outcome of the project.

Selection criteria

The following criteria should be considered (if relevant) in selecting the site within a city:

- the fit with the local transport strategy and air quality strategy;
- the practicality of the site (e.g. access to refuelling points);
- the possibility to acquire the data needed to achieve the objectives;
- the potential environmental benefits of the selected transport service (e.g. whether particulate emissions are reduced in the busy city centre or along less densely populated routes);
- the travel behaviour and demographics of the users at alternative sites;
- public and stakeholder acceptance;
- the opportunity to introduce supporting measures, such as bus lanes to enhance a Park & Ride service;
- the match between the operational requirements of the route and the performance of the vehicle (range, hill-climbing etc.).

Nevertheless, other subjective factors inevitably play a role, such as political expediency, opportunity, vested interests and funding availability. Barriers may be encountered at the preferred site, such as high costs of moving utility services to install bus lanes. A compromise site may have to be picked in these circumstances.

Depending on the project objectives, more than one route/location may be desirable within a city. For example, it may be important to compare the effects of different traffic conditions, different types of user, or different sets of supporting policy measures.

Local policy-makers will be interested in how the proposed project fits within (and competes with) the existing modes of transport operating in the test site area. For larger metropolitan areas, three geographic areas may need to distinguished:

Consider impacts on three traffic zones:
- city centre;
- inner urban area;
- outer urban area.

- the city centre area where on-street parking is restricted and other measures may also act to restrict private car usage,
- the inner city area where a high level of public transport is offered, and where traffic management measures aim to keep the road traffic moving, and
- the hinterland urban area where lower densities and frequencies of public transport services mean that the private car is the dominant mode of travel.

Site selection from a programme perspective

In proposing a site, the project team should also consider the national/European perspective, especially where funding has been sought from a Government programme.

National/European selection criteria

For example, criteria for project and site selection may have been defined by funding agencies based on policy objectives. The following factors are generally important:

- contribution of the project to Government programme objectives (e.g. concerning the choice and spread of technologies, required site characteristics, type of impacts, and the use of supporting policy measures);
- credibility of the proposers;
- acceptance and involvement/commitment by an adequate range of stakeholders (including users, local transport service providers, political authorities and suppliers);
- credibility of the project planning and budgeting (in terms of meeting the proposed objectives);
- financial viability of the project in the absence of Government funding (i.e. would it go ahead anyway?);
- potential commercial viability and potential for replication of the transport solution to be demonstrated (if this is relevant to the objectives of the project);
- likely effectiveness of the dissemination strategy in influencing other cities;
- potential energy and environmental benefits of the transport solution to be demonstrated (either within the project, or more likely, in subsequent market application);
- potential effects on modal shares;
- possibility to acquire the data needed to achieve the objectives;
- validity of the site for providing transferable and exploitable results;

- ability to overcome barriers such as planning regulations;
- risks (technical, political, institutional, safety etc.);
- expected stability of test site conditions and characteristics;
- degree of innovation (technology, transport concept);
- contribution of the technology choice to the national/European economy and competitiveness;
- competition with existing modes of transport;
- "value for money" (in terms of benefits per unit of cost).

In multi-city and multi-country projects, the choice of complementary sites, the credibility of the proposed management approach and the design of the cross-site evaluation strategy become important additional criteria.

Example: Swiss large-scale EV fleet test in Mendrisio

In selecting Mendrisio for a large-scale EV test, the Swiss Federal Office of Energy considered the following characteristics of the site as ideal:

- *Good conditions to reach a high density of EV's*: not too many inhabitants, an existing dealer and service network, an environmentally-aware population, a high percentage of inhabitants with a high income, a high percentage of second cars (in households), and a strong and enthusiastic industry.

- *Demonstration potential*: good tourist image, a high traffic density (as good conditions to demonstrate and evaluate promotional measures), situated close to a big town (to demonstrate the substitution of short distance trips), and highly developed public transport systems (to demonstrate good combinations with EV's).

- *Structural conditions*: a well-defined test area with little external traffic, and existing statistics as a database for investigations.

How to minimise bias in the site selection decision

In an idealised world, the site should be selected to meet the needs of the project objectives and other criteria defined by the stakeholders. In some projects, this will not be the case, since the whole scheme may be site specific. However, in projects where there is a choice, care is needed to minimise bias in the selection decision.

Sources of bias

Bias may result from:

- certain sites acquiring front-runner status (e.g. due to their profile from previous projects);
- lobbying by people who want to secure the prestige of a demonstration project (for political, personal or commercial reasons) even if their site is not the most suitable;
- favouritism for sites that seem to offer the best chance for a desired positive or negative outcome.

Minimising bias

Ideally, independent experts with a full knowledge of all the alternatives should carry out the selection of sites. In many cases this may not be practical, or may be deemed too expensive or time-consuming. Often the only evidence available to national or European programme managers is a site proposal written according to some standard format. To minimise the influence of bias in the process, the following steps are recommended for decision-makers:

- Make explicit the selection criteria, and any scoring and weighting system that may be used.
- Minimise the use of subjective criteria.
- Provide "no-commitment" advice to teams developing site-specific proposals on how to meet the selection criteria more effectively.
- Encourage site teams to make all reasonable efforts to gather and present relevant and accurate data, e.g. by providing templates and worked examples of site proposals.
- If feasible, organise a face-to-face session where the bid evaluators can clarify bids with the proposal teams.
- Document and disseminate the results of the selection process, making explicit the basis for both the acceptance of the selected site and the rejection of the other sites.

The site-specific proposal, the decision and associated evaluation form a critical part of the plan for the project against which progress should be assessed. These need to be recorded as part of the quality assurance for the project.

Summary of good practice

Good practice

Recommended good practice for site selection is as follows:

- Define criteria that will test the ability of the site to meet project objectives and the interests of stakeholders.
- Include feasibility criteria based on the project risk analysis.
- Check the site proposal against criteria defined by national and European funding agencies, where appropriate.
- Minimise bias in the site selection procedure by making the procedure open and objective.

In this Section:

- How do my objectives affect the requirements for evaluation?
- What are the different stages of evaluation during the project?
- What data collection is needed?
- What evaluation methods are appropriate?
- How do I measure vehicle environmental impacts?

3.3 What are the critical aspects of evaluation?

The main issues

How do the detailed objectives of my project affect its evaluation? What is the possible influence of national and European programmes and their objectives?

What should be the content and process of the evaluation through the project lifecycle?

What data collection is needed, and how should the results be evaluated?

What are the particular challenges in assessing the environmental performance of alternative-fuelled vehicles?

The main stages of evaluation through the project lifecycle

There are three main stages of evaluation:

- initial evaluation, as part of the decision on the project (see also Section 2.2),
- ex-ante evaluation, when setting up the project in detail (see also Section 3.1), and
- ex-post evaluation, when actual results are available (see also Section 4.2).

Evaluation should be a continuing process during project implementation, to allow corrections to the experimental design if necessary.

See Sections 4.2 and 5.1 on ex-post evaluation.

Ex-post evaluation extends from the assessment of the project itself (see Section 4.2), to learning about the implications for the future (see Section 5). The ex-post evaluation should determine the extent to which the implementation in the field test has attained the initial objectives for the project.

Planning for evaluation

The evaluation planning is carried out during the two main stages of project design work.

Initial evaluation strategy

The initial plan/strategy for the evaluation is developed as part of the preliminary design of the project (see Section 2.2 Step 6). It provides an overview of the required measurements and analysis related to the expected effects of the project, key indicators, data collection sources and procedures, and evaluation techniques. It should distinguish which of these elements will be used in the initial, ex-ante and ex-post evaluation stages.

The initial evaluation itself is made on the preliminary design (see Section 2.2 Step 7). This activity should assess whether the evaluation plan will deliver the essential measurements and indicators (e.g. can modal shift be adequately evaluated?), as well as estimating the likely outcome and impacts of the project.

Full evaluation strategy

The development of the complete evaluation procedures may be left until the go/no-go decision has been taken on the preliminary design of the project. The evaluation plan will then need to define in detail the work to be done for the ex-ante and ex-post evaluation stages. It is an integral part of the detailed design of the project, since the field work must include the necessary data collection and measurements from the start.

Benefits of an effective evaluation strategy

A well-designed initial evaluation strategy will strengthen all the subsequent evaluation work, providing a clear sense of direction and purpose to the effort. It makes the project more cost effective because it prevents:

- ‘down time’, caused by ad-hoc decision making;
- waste of staff time on the collection and analysis of data that are irrelevant to the questions addressed;
- duplication of data collection;
- inconsistency in data collection that prevents comparison between sites in larger (multi-city) projects;
- weaknesses in project design that prevent certain evaluation needs being met. (For example, if modal shift is an objective, the project has to be sufficiently large in scale to achieve a measurable shift, and the ex-ante evaluation must include the collection of data on modal shares before the new transport solution is implemented.)

The evaluation strategy will need to take account of any requirements of national or European funding bodies. These may dictate that certain indicators are measured so that comparison can be made between the results of different projects.

Use of independent evaluators

Some projects (such as Praxitèle) have chosen to sub-contract their evaluation work to independent organisations. This increases the objectivity of data interpretation (although, of course, these organisations do tend to become enthusiasts after a few years working with the project). However, a close collaboration is required with the project stakeholders, designers and data generators. For example, the Praxitèle evaluators found operating staff initially reluctant to provide detailed reports on non-commercial trips (e.g. for cleaning and maintenance of vehicles). This reflected the extra workload being requested. In the UK field trials of alternative-fuelled buses and vans, the evaluation team scrapped a draft standardised data collection procedure, and instead provided bespoke procedures to fit with the existing information management practices of the individual fleet operators.

The purpose of each stage of evaluation

Initial evaluation

The initial evaluation takes place after the preliminary design and the evaluation strategy have been prepared. It provides a simple overall evaluation of the project, alternative approaches/sites, and whether the planned work should be adequate to show unambiguously whether or not the project has reached its objectives.

Ex-ante evaluation

The ex-ante evaluation takes place after the detailed design stage, with the project ready for implementation at a defined site. It is still a prospective (forward-looking) evaluation, and the emphasis is on what is likely to happen with and without the project. It has three main purposes:

Goals of the ex-ante evaluation:
- check the initial evaluation;
- check the detailed design and evaluation strategy;
- provide the baseline for the ex-post evaluation.

- to review the initial evaluation;
- to provide the baseline of comparison for the ex-post evaluation;
- to provide a check on the detailed design and evaluation strategy.

The ex-ante evaluation includes:

- Measuring the "before" situation, as an input to the estimation of the baseline outcome "without" the project.
- Estimating the likely impacts of the project – the specific impacts of the project itself, and the impacts if wider exploitation of the transport solution is achieved. (The latter estimation is only needed if this is relevant to the objectives of the project).
- Assessing whether the design, evaluation measurements and methods, and expected results can satisfy the objectives of the experiment (e.g. demonstration of modal shift).
- Determining whether to modify the design and the measurements plan where appropriate, or even abandon the project if necessary. (Go/no-go decision point prior to implementation).

Ex-post evaluation

The ex-post evaluation, in contrast, is retrospective (backward-looking). The process is focused on the observed results of the completed or ongoing project. The results are compared with the ex-ante estimate for the results and with the ex-ante evaluation of the situation without the project. The findings of the ex-post evaluation will be the basis for making any final projection of the likely effects of a full implementation.

> The critical feature of all three stages is that the evaluation must be targeted on measuring progress against the defined objectives of the project.

"Before - after" and "with - without" comparisons

It should be noted that the "before" data are often not the same as the *forecast* data for the "without" situation one or two years later when the project has been completed. For example, traffic may be expected to grow under current trends over the project time-scale. The ex-post evaluation will need to make a "with-without" comparison at the end of the project, rather than a "before-after" comparison. Of course, the "without" results cannot be measured, but have to be estimated from the "before" data.

Developing the evaluation strategy

The first step in the development of the evaluation strategy is to translate the project objectives into impacts to be evaluated. This means defining specific questions and hypotheses that are open to measurement, which would show whether the results/impacts of the project have satisfied the objectives. The initial evaluation then provides a first forecast of the expected level of these impacts and indicates whether this justifies the project implementation.

The main steps in developing the strategy are therefore:

1. to derive a list of impacts and associated indicators to observe and monitor;
2. to forecast impacts on the basis of the project's preliminary design;
3. to choose appropriate data collection and evaluation methods;
4. to evaluate whether the expectations justify the project's implementation;
5. to establish a detailed evaluation plan for the remainder of the project.

Later in this Section, advice can be found on the selection of impact categories, indicators and evaluation methods.

Five steps in developing the evaluation strategy:

- select impacts and indicators;
- estimate impacts;
- choose evaluation methods;
- assess project feasibility;
- plan the detailed evaluation.

Cross-city evaluation

As discussed in Section 3.1, multi-site projects allow site-dependent and site-transferable conclusions to be distinguished. Alternatively this can be achieved by individual single-site projects working within a common evaluation framework specified at the national or European programme level.

See Section 3.1 on multi-site projects.

The basic requirement is to agree a set of common indicators, measurement and evaluation methods that are feasible at all sites. This will form the core of the evaluation, to which individual sites can add other investigations. A critical part of this common approach will be the recording of site characteristics that allow the effect of the site context to be assessed.

Example: Building a key indicator inventory for the CENTAUR project

CENTAUR involved 9 cities using vehicle, systems and infrastructure measures to achieve energy-saving targets.

A common evaluation framework was agreed, based on a spreadsheet model for quantifying energy and pollutant emission savings. This was applied to each measure or package of measures implemented. A common interest in measuring social acceptance was also found.

One of the biggest challenges for this project was achieving evaluation at common geographical levels that reflected the different extents of impact of the various measures. Whilst some vehicle innovations had local effects, other measures required evaluation over a wider area. There was a focus on impacts along bus lines and corridors, and this became an important geographical level for measuring impacts. By continual refinement of the framework, it was possible in most cases to achieve a common geographical level of evaluation at different sites applying a similar measure.

It should be noted that maximising the common results often requires an individual site to evaluate its measures at more than one geographic level – and that the integration of the results must take care not to introduce double-counting of energy savings.

Defining project impacts and indicators

Impacts and indicators should be derived from project objectives

The choice of impacts and indicators is the core of the evaluation strategy. They measure to what extent the project objectives are achieved, and must be capable of reliable assessment.

The following procedure may be used in selecting the impacts and indicators to consider:

1. Derive from the objectives and conceptual design the *intended* and other *possible* impacts the project may cause, building structural relationships of causes and effects (e.g. in a tree diagram).
2. Check this list for completeness using the set of generic impacts provided in Table 3 below (which has been derived from the experience of previous projects).
3. Consider using Table 3 to build a structured classification of the impacts of interest to the project. This can facilitate multi-criteria analysis of the overall outcome of the project.
4. Match one or more indicators to every impact.

Table 3: Generic impacts of a demonstration project

Impact category	Impact	Sub-impact
	Transport solution performance	
Technical performance	Operating logistics	• Ease/speed of refuelling • Technology reliability/availability/ downtime • Vehicle driving characteristics and driver comfort • Vehicle maintenance, and disruption due to poor availability of spare parts • Vehicle capacity and range
	Journey performance	• Journey times/ commercial speed • Waiting times • Delay/system reliability, adherence to timetable
	Quality of service	• Information • Cleanliness • Comfort • Service frequency • Perception of personal security
Effect on the transport system	Intermodality	• Competitiveness of mode (change in modal share) • Ease of intermodal transfer
	System capacity	• Network capacity, route capacity • Supply and demand matching • Service frequency
	Demand	• Total passenger/tonne/vehicle km travelled • Number of travellers, number of trips • Length and purpose of trips • Traffic speeds, volumes and congestion • Vehicle load factors/ occupancy • Route changes, changes in origins and destinations
	Accessibility	• Vehicle access • Access to destinations

Impact category	Impact	Sub-impact
Costs	Costs to project sponsors	• Total project cost • Search costs for capital (including proposal preparation costs) • Project management and evaluation costs
	Costs to operator	• Investment costs (vehicles, labour, refuelling infrastructure, land, other infrastructure and equipment, training) • Operating costs (vehicle, fuel, labour, maintenance) • Costs of unreliability • Operating revenues
	Costs to user	• Up-front costs • Variable costs/ service tariffs • Costs of changing transport system • (Value of) changes in journey times
	Socio-economic effects	
Environmental impacts	Primary energy use	• Fossil, nuclear, renewable energy use
	Local pollution	• Emissions/ air quality (CO, NO_x, HC, PM, SO_2) • Soil/water pollution • Waste generation/ disposal/ recycling
	Global warming	• CO_2 (fuel use), methane emissions
	Nuisance	• Noise and vibration • Visual intrusion/ townscape effects • Community severance
	External costs and benefits	• Costs of global warming, health impacts and material damage • Costs of congestion to the economy and society • Costs of accidents • Changes in physical fitness
Safety	Accidents and near misses	• Vehicle users • Other transport users and the general public • Operating staff
	Perception of safety	• Vehicle users • Other transport users and the general public • Operating staff

Impact category	Impact	Sub-impact
Social cohesion and Quality of Life		• Mobility – discretionary trips • Equity (between social/income groups) and social exclusion • Working conditions • Care for marginal/ disadvantaged groups • Freedom of choice
Economic		• Costs to businesses • Employment creation/ destruction • Land-use patterns • City centre trade • Competition between transport providers and viability of public transport services • Public investment needs (e.g. for transport infrastructure) • Transport service prices
Acceptance/ perceptions of the transport solution (including technologies and policy measures)		• Acceptance by users • Acceptance by general public • Acceptance by competing transport service providers • Acceptance by operators and their staff • Acceptance by local authorities • Acceptance by media • Acceptance by minorities
Expectations of the future potential of the transport solution		• Expectations of vehicle and fuel suppliers • Expectations of vehicle purchasers • Expectations of service users • Expectations of policy makers • Expectations of the media and the general public
Learning		• Formation of new stakeholder networks • Development of new institutional procedures and partnerships

Overview of key indicators for vehicle projects

Transport solution performance

Indicators of *transport solution performance* assess the effectiveness of a new service in terms of its technical characteristics. These indicators are particularly important in projects aimed at technology testing. They include effects on the transport system as well as vehicle performance. Results may be calculated for the project itself, and/or estimated for the full-scale implementation of the transport solution. (However, it should be noted that the extrapolation to full scale is often non-linear and therefore uncertain.)

Socio-economic effects

Indicators of *socio-economic effects* estimate the benefits and damage derived from a project and its follow-on/scale-up options. Quantitative indicators are often evaluated in relation to the costs associated with the transport solution:

- project benefits versus total project costs;
- project benefits versus the technology implementation costs (i.e. excluding management, evaluation and dissemination costs of the project that are not intrinsic to the transport solution);
- forecast benefits versus forecast costs of the transport solution in the longer term.

The latter two analyses are particularly important in projects aimed at changing market behaviour, where the societal benefits of the transport solution in wider implementation are usually of greater interest than the short-term "value-for-money" of the project.

The *transport solution performance* includes the "internal" costs due to the project (financial outlay, value of time savings etc.). The *socio-economic effects* on the other hand consider the external costs. These costs need not necessarily be expressed in monetary terms. However, depending on the project, this level of sophistication may be necessary to give a fair comparison between different fuel options – see below.

Environmental impacts

In a clean vehicle project, the evaluation of environmental impacts is usually of critical interest. Often, the project stakeholders are interested in assessing not only the specific effects of the project, but also the potential environmental benefits of the demonstrated transport solution in wider deployment. This usually involves the modelling of traffic levels, vehicle emissions and air pollutant concentrations now and into the future.

The environmental results will be of great interest to other cities across Europe, particularly noise, CO_2 and local air pollutants. There is a general shortage of data on the emissions performance and fuel use of clean vehicles under real-life operating conditions.

In addition, cities may be interested in *derived* impacts, such as the estimated contribution of vehicle emissions to air quality problems, damage to human health and historical buildings, contribution to global warming potential, and overall external costs. Analysis of emissions over the lifecycle of fuel production and use will often be needed to allow comparisons between different fuel types.

External costs

What is the relative impact of different pollutant species?

The European Commission's ExternE projects have pulled together the state-of-the-art understanding of the external costs imposed by pollutant emissions. These costs result from e.g. damage to human health, buildings and crops. For typical urban conditions, the *approximate* costs due to vehicle exhaust emissions (per tonne of that pollutant) are:

CO	500 Euro/tonne
HC	900 Euro/tonne
NO_x	10000 Euro/tonne
PM_{10}	20000 Euro/tonne
CO_2	30 Euro/tonne.

Safety and security

A check on safety is usually important both for transport systems and for innovations. The most common use of the word *safety* is for the *objective* measurement of deaths, injury and property damage from transport accidents. However, transport safety may also refer to travellers' *subjective* feelings of safety while using a new transport system – this is often termed *security*.

In the specific case of alternative fuels, the users' perception of safety is at least as important as the objective level of safety. This is also significant for the staff involved in driving, maintaining and refuelling the vehicles. An individual project may not have a *measurable* effect on safety in terms of accidents. However, it could have a significant effect on perceptions of security and thus on the market acceptance of a new transport solution.

In these Guidelines the focus is on measurable data (quantitative or qualitative) that match the expected impacts and the objectives of the project. For many cleaner vehicle projects, qualitative data on the sense of security of passengers and operatives may be the most important in this impact category.

User acceptance

More generally, sampling of user acceptance may be regarded as essential in any project that is trying to introduce new transport concepts and change travel behaviour. This can help the project stakeholders to check the feasibility of moving from pilot scale to full-scale implementation in the market.

Prioritisation of evaluation work

In order to prioritise evaluation efforts, it is useful to categorise the impacts in terms of:

- *Stakeholder interest:* Does the impact affect the self-interest of one or more stakeholder groups in a critical way?
- *Geographic scope:* Does the impact hit locally, or does it influence a wider region (such as the effects of global warming)?
- *Importance:* Must the impact be measured so that the attainment of core project objectives can be assessed?
- *Longevity:* Will the impact continue to exist after project completion or not?
- *Tangibility:* Can the impact be physically measured during the project, or must it be forecast (such as the contribution to improvements in ambient air quality)?

Characteristics of impacts:
- stakeholder interest;
- geographic scope;
- importance;
- longevity;
- tangibility.

This will help the project team to focus resources on the most important impacts and indicators. Nevertheless, the evaluation strategy should also be open to capturing unexpected side effects and adverse impacts.

It is useful to identify the impacts and indicators that are most critical to each of the project stakeholder groups. This can be used in the marketing and communications strategy to target information. It also provides a check that the evaluation strategy takes account of user acceptance, stakeholder objectives and potential sources of opposition.

Data gathering strategy

The evaluation requires information about specific conditions or events both before and after the project implementation – for example, the number of people who used public transport in a particular month, the construction cost of a vehicle recharging station, the particulate emissions of an LPG bus, and so on.

Data will also be needed for a comparison between an expected performance level and the actual outcome observed. An example might be the proportion of bus users who have switched from driving their cars.

Analysis of the data aims to reveal whether the observed conditions or events can be attributed to the project (cause and effect). For example, if we observe changes in the use of a park-and-ride system, what part of those changes is the effect of substituting electric for diesel buses?

Elements of the data gathering strategy:
- kind of information;
- sources of information;
- sampling methods;
- information collecting methods;
- timing and frequency of information collection.

Important elements of the data gathering strategy, then, are:

1. the kind of information to be acquired,
2. the sources of information,
3. the methods to be used for sampling sources (for example, random sampling),
4. the methods of collecting information (for example, structured interviews, traffic counts, self-administered questionnaires), and
5. the timing and frequency of information collection.

For the initial and ex-ante evaluations, the data will usually be gathered by market research, for example by interviewing or surveys, or by measurements, for example of current traffic flows and modal choices. The opinions gathered must provide a representative overview of all actors involved, or else the subjective choices of the dominant actors will prevail. Any measurements should be representative of the general transport conditions in the chosen study area.

Investigation of project experiences

For the ex-post evaluation, additional indicators can be collected based on the experiences within the project. For example, previous projects have found it helpful to study the following aspects:

- *The experience of vehicle operations*. Records of fuel use and maintenance should be supplemented by interviews with drivers, workshop staff and passengers concerning their satisfaction and any specific problems. Log books and diaries may complement the technical records.
- *The experience of safety issues*. Managers, drivers, workshop staff (especially refuelling supervisors), passengers, the local population

and planning authorities can all be consulted. Topics include both the procedures for ensuring safety and the perception of safety.

- *The experience of fuel supply and refuelling*. Again, interviews with the people involved are important.
- *The effects of the demonstrated technology or transport service on user behaviour*. Modal choice is often a key interest here. One of the issues is to determine whether a project has increased travel demand and/or moved demand from other modes (and if so, which ones?). For a new service, it is also useful to determine the trip purposes for which the service is used, the characteristics of people using the new service, and the reasons why they use it. Non-users may be asked about the barriers to using the service. Short structured interviews are effective, in sufficient number to ensure that the results are representative. This complements the analysis of e.g. bus occupancy data.
- *The effects of the demonstrated technology on perceptions*. This should be differentiated between, for example, bus users (who may perceive little difference between a new gas bus and a new diesel bus) and the general public (who may be more perceptive of changes in vehicles passing their door).

Evaluate results while the project is running.

The project management should build a close working relationship with those responsible for collecting and submitting data on a regular basis. This helps to promote data integrity and can bring to light significant observations that were not envisaged under the data collection plan.

Adequate resources must be assigned to the *ongoing* evaluation of data, rather than leaving the evaluation to the end of the project. For example, if one vehicle in a fleet has abnormally high fuel consumption, early data analysis allows investigation and correction of the problem. Also, as discussed in Section 4, intermediate assessments allow more timely preparation of the follow-up to the project. The final report itself is often too late to influence events.

Example: Vehicle fuel consumption

In the EC JUPITER-2 project, four CNG buses were on trial in Southport in the UK. Three buses had fuel consumption around 21 MJ/km, the fourth achieved only 28 MJ/km. Early analysis of the data allowed the cause to be located and tackled.

In this sub-section:
- emissions testing;
- measurement of fuel use;
- comparison between vehicles and fuels.

Data gathering for environmental assessment

Environmental benefits are a primary driver for clean vehicle projects. In many cases, obtaining proof of these benefits is an explicit objective.

The environmental assessment centres on the assessment of vehicle emissions. Input parameters that may need to be measured are:

- the vehicle-specific emissions factors (grams per vehicle kilometre) for a range of pollutant species, which depend on vehicle speed, ambient temperature, engine temperature, the extent of stop-start driving, and other parameters;
- the changes in vehicle kilometres and traffic flow conditions resulting from the project;
- air quality (although only the largest vehicle projects are likely to have a significant immediate effect on total pollutant concentrations);
- vehicle and ambient noise levels.

Steps in environmental assessment

There can be several stages to the assessment:

- *determination of demand* – changes in vehicle kilometres driven by the clean vehicles and other vehicles affected by the project (including as a result of modal switching);
- *determination of traffic conditions* – changes in vehicle driving conditions (speeds, stop-starts, route choice etc.), per vehicle type;
- *determination of vehicle stock* – changes in the numbers of each type of vehicle technology;
- *estimation of vehicle emissions* – the aggregate effect of changes in demand, traffic flow and vehicle stock on the total emissions of each pollutant species and noise;
- *estimation of effects on air quality* (as opposed to direct measurement) – changes in the ambient concentration of pollutants in the atmosphere;
- *estimation of environmental impacts* – effects of increased pollutant concentrations on human health, buildings, crops and other receptors;
- *estimation of external costs* – the monetary value of the impacts.

Projects vary in their assessment needs depending on the agreed objectives. Budget constraints will also influence the complexity of the evaluation. Some projects seek to forecast the environmental effects of full-scale implementation of the demonstrated technology, in which case the demand/traffic effects need to be identified (possibly 5–10 years ahead). Other projects focus on determining the emissions factors for a new vehicle technology under real-life conditions, relative to the conventional technology to be substituted.

Life-cycle analysis

Some projects will include life-cycle analysis to take account of emissions during the production and supply of the vehicles and fuels. This is essential for the comparison of fuel options such as diesel versus electricity. The life-cycle analysis should be combined with an estimation of environmental impacts, since a given quantity of particulate emissions from a diesel exhaust in a densely populated urban area will cause much greater damage than the same quantity of particulate emissions from a power station in some remote rural location. The life-cycle results may vary substantially from country to country, depending on e.g. the electricity generating mix.

Generally speaking, technology demonstration projects focus on the vehicle and life cycle emissions indicators, while pilot projects for radical transport solutions require a more comprehensive treatment of traffic effects.

Thus there are three main elements to environmental evaluation:

- traffic data gathering;
- vehicle emissions data collection;
- calculation of emissions and impacts.

Three elements of environmental evaluation:
- traffic data gathering;
- vehicle emissions data collection;
- calculation of emissions and impacts.

(In addition, good practice in environmental management requires other impacts *of the project* to be assessed. This is discussed elsewhere in these Guidelines.)

Traffic data gathering, as an input to e.g. road network models, has well-developed methodologies that are not specific to clean vehicle projects. Similarly the use of vehicle emissions, air dispersion and life cycle modelling is becoming well understood by transport professionals. Therefore these topics are not discussed here in depth. However, it should be noted that a variety of different models exist, and their level of complexity needs to be matched to the questions raised by the project objectives. For example, so-called "average speed" emissions models may be adequate for assessing the overall effects of a new technology, but the more detailed "vehicle kinematics" approach may be appropriate where accurate assessment of air quality effects is required at some specific location.

Vehicle emission factors

The measurement of emissions factors for alternative-fuelled vehicles remains a critical issue. Relatively few data have been published, and the data rapidly become outdated as the technologies improve. Often the data are based on samples of few vehicles, and therefore are not statistically reliable. The standard data supplied by the vehicle manufacturers are derived from the regulatory drive cycles for light-duty vehicles and heavy-duty engines, and often do not represent the performance under real-life driving conditions (such as congested traffic). Fuel consumption and emissions can vary significantly between similar vehicles produced by different manufacturers.

Example: French CNG bus trials

Measurements of fuel consumption carried out during 1999 and 2000 revealed that CNG buses had an excess fuel consumption relative to diesel ranging between 28% and 62%, depending on the make and model of the CNG and diesel bus tested. These results were obtained for a drive cycle representative of congested urban driving (average speed 10.5 kph). CNG buses included both carburettor and multi-point injection engine technologies.

Example: UK Government field trials of alternative-fuelled vehicles

Trials carried out during 1995 and 1996 illustrated various sources of uncertainty in emissions data. For example, hydrocarbon emissions from the latest LPG and CNG vans were on a par with diesel hydrocarbon emissions at gentle temperatures and traffic conditions, but at least 500% higher over a cold-ambient, cold-start congested traffic cycle. (Since then, developments in exhaust catalysts specifically tailored for gas-fuelled vehicles may have reduced this problem.) NO_x, CO and CO_2 emissions were also *relatively* higher for the gaseous fuels under the more extreme conditions (reflecting basic differences between spark ignition and diesel engines). State-of-the-art CNG and LPG engines were found to give far better emissions performance (and reliability) than earlier conversions of gasoline and diesel engines to gaseous fuels. Fuel consumption varied by 5–10% between nominally identical vehicles

Good practice for energy and emissions measurements

Experience from clean vehicle projects leads to the following recommendations for emissions and fuel consumption measurements:

- Where possible, compare the alternative-fuelled vehicle back-to-back with the equivalent conventional-fuelled vehicle (same size and model, similar engine size, running over the same routes with the same operational duties). Often this is essential if vehicle operators are to be convinced of the technical (and perhaps commercial) viability of alternative fuels.

Select the appropriate (advanced) conventional technology as a benchmark.

- The benchmark technology should be selected with reference to the city context and the project objectives. For example, are gas-fuelled buses deemed to be in competition with “standard” diesel buses, or with the most advanced diesel buses running on ultra-low sulphur diesel and fitted with a particulate trap? The benchmark technology should also have a similar performance in meeting the operational demands of the specific application.

Ensure emissions data are statistically reliable.

- Emissions tests should be carried out on more than one vehicle of any given model, in order to assess the statistical reliability of the results. For example, in the French CNG bus trials, two “identical” vehicles in the same fleet showed a 25% difference in torque and significant differences in pollutant emissions (especially CO) and fuel use. Such variations can also be found in the conventional fuelled vehicles used as benchmarks. Ideally up to ten vehicles should be tested.

Collect emissions data that represent real-life driving conditions.

- Emissions data representing real-life driving conditions can be obtained using special drive cycles to test the complete vehicle on a rolling road chassis dynamometer. (This is particularly relevant for heavy-duty vehicles where the regulatory standards only require static engine bench tests, and not whole vehicle tests. However, only a small number of laboratories have dynamic heavy-duty vehicle dynamometers at their disposal.) Some drive cycles such as the TNO bus cycle have an international profile. It is relatively easy to record a drive cycle (i.e. speed-time pattern) under local traffic conditions, but this reduces the transferability of the results to other cities.

- Another option is to use a more sophisticated *dynamic* engine test bench and to test engines over a load pattern derived from a realistic drive cycle.

- In the case of electric, hybrid and fuel cell heavy-duty vehicles, the regulatory static engine test is not meaningful, so whole vehicle tests are usually required.

- Technology testing projects may need to carry out the dynamometer tests in a temperature-controlled chamber, to explore the effects of ambient temperature on emissions. (The regulatory drive cycles require an ambient temperature between 20^o and 30^oC, which is not representative of winter-time conditions.)

- Emissions data may also be measured on board a moving vehicle, using specialist equipment. In the UK Government field trials of alternative-fuelled vehicles, this method was used for buses running round a test track, with the driver following the recorded speed profile of a bus moving in heavy traffic. (If the measurements are made in real traffic, it is difficult to test different vehicles under exactly the same conditions.)

- Dynamometer tests are relatively expensive. Therefore the French CNG bus trials have demonstrated a cost-effective way of combining dynamometer tests with tests on static vehicles. Exhaust emissions were tested first in free acceleration and idle tests in a workshop using mobile equipment, allowing ten CNG buses and ten diesel buses to be tested. This allowed the inter-vehicle variability to be assessed. The most representative vehicles were then selected for the more costly (but more representative) dynamometer testing.

Consider combining dynamometer tests with simpler emissions tests.

- Dynamometer tests should be repeated after perhaps one year of operation if any degradation in emissions performance is to be checked. The first batch of testing should not take place immediately on new vehicles, since the vehicle maintenance team is likely to require some months to learn how to get the best performance out of the new technology.

- Test results should be obtained using a single batch of reference fuel, despite the costs of storage between tests. This is to avoid the uncertain variability in results with changes in fuel composition. It is preferable to use industry standard reference fuels (where these exist, e.g. for diesel and gasoline) rather than pump fuels, as this aids comparison between projects.

Use a single batch of reference fuel for emissions testing.

- Fuel use should be measured in daily operation according to standard fuel management procedures. It can then be checked using the CO_2 emissions data or energy consumption data from the dynamometer tests. It should be noted that volumetric and mass-based measurement of gaseous fuel consumption *can* give inconsistent results, because the measurement methods are not well-defined.

- Daily operations and events should be logged, as well as maintenance actions. This is to allow changes in fuel consumption and emissions to be traced to possible causes.

Record the experiences of daily operations.

- Reliable measurement of fuel use requires data to be recorded over several months at least. In this way, the effects of variations in traffic, weather, seasonal demand etc. can be taken into account. Fuel use

Monitor fuel use regularly over several months.

should not only be measured, but also analysed on a continual basis (daily/weekly). In this way, any deviations from normal performance can be spotted quickly, their causes investigated and remedial action taken if necessary. Data that are clearly not representative can then be omitted from the calculation of the typical performance.

- A general problem occurring with electric propulsion systems is that a dynamometer measurement tends to over-estimate the effect of regenerative braking. In practice, the brakes on the non-driven wheels are also applied during braking of the vehicle (dissipating energy), but on a two-wheel dynamometer all braking is done by the driven axle (recovering energy).

Emissions test procedures for new technologies are in their infancy.

- For fuel cell vehicles, the measurement of emissions is not yet standard practice in vehicle test laboratories.
- The evaluation of energy use for electric vehicles will require electricity production to be taken into account.
- For series-hybrid vehicles that do not take their charge from an external source, measurement of energy use by the engine-generator set has to take account of the state-of-charge of the battery.
- Bi-fuel vehicles (e.g. LPG/gasoline vans) that allow the fuel to be changed at the flick of a switch are particularly useful for emissions evaluation, as the effects of inter-vehicle variability on emissions data can be eliminated. However, this is not possible for all fuel combinations. Moreover, alternative fuels perform best in dedicated engines. Typically this means that new projects using the latest technologies will have to compare single fuel vehicles, requiring larger numbers of vehicles to be tested in order to obtain statistically reliable results.

Project evaluation methods

In this sub-section:
- overall evaluation of the results;
- methods for evaluation;
- multi-criteria analysis of vehicle projects.

The process of evaluating the results of a vehicle project can be considered to have three elements: data collection and measurement, estimation of indicators for individual categories of impact, and overall evaluation of the project outcome across the range of impacts. This sub-section describes the relative merits of alternative methods for the *overall* evaluation.

Methods for project evaluation include simple descriptive assessments, multi-criteria analysis, cost-effectiveness and cost-benefit analysis. The appropriate level of detail and sophistication of the assessment will be different at the different stages of the project's lifecycle, and will depend on the project objectives and data availability/cost.

Monetary versus non-monetary methods

A key distinction is between monetary and non-monetary methods of evaluation. Monetary methods may be used when the most important project impacts can largely be expressed in monetary terms. Examples of monetary methods are cost-benefit analysis (CBA) and cost-effectiveness analysis (CEA).

Non-monetary evaluation methods are used when the majority of the important project impacts cannot be expressed in monetary terms. Examples of non-monetary methods are multi-criteria analysis (MCA) methods and survey table methods such as goal achievement matrices (GAM).

For further information on how to use these methods, the reader should consult a standard reference book.

The choice of an evaluation method depends on:
- institutional factors;
- characteristics of the method;
- characteristics of the decisions to be taken.

The factors on which the choice of a suitable evaluation method depends can be classified under three headings:

- *Institutional factors* are procedures or directives that are mandatory in certain evaluations, such as those of very large projects.
- *Characteristics of the method* must be considered against such factors as the time available, the desired depth of research, the availability of data and the availability of the expertise required. For example, CBA calculations are not applicable if most of the effects cannot be expressed in terms of money.
- *The characteristics of the decisions to be taken* may imply that a particular evaluation method is the most appropriate. The project objectives will imply that certain impacts are particularly important, and different decision criteria may apply at different stages of the project lifecycle.

For example, studies aimed at determining the profitability of a transport solution can only use a CBA; other evaluation methods cannot determine the profitability of projects. For studies seeking only to prioritise a number of alternatives, it would be better to use a ranking method such as CEA in place of CBA. For projects that aim to learn about new transport solutions, MCA can be used to structure the available information and to take account of multiple stakeholder perspectives.

There is an inevitable trade-off between the cost and quality of evaluation.

Inevitably, there has to be a trade-off between cost and quality of evaluation in every project and this depends on the budget and type of project. Also, the range of stakeholder interests may require the evaluation to be broader than e.g. the commercial focus of the leading vehicle operator. In terms of the cost, detail/accuracy and breadth of the data collection and evaluation effort, the trade-off has to be explicit and acceptable to all relevant actors. Moreover, the project team has to be confident that they are not jeopardising their ability to measure the critical aspects of performance against the project objectives.

Monetary evaluation methods

CBA and CEA compared

Cost-benefit analysis (CBA) and cost-effectiveness analysis (CEA) are the best known and most widely applied of the *monetary* evaluation methods relevant to pilot and demonstration projects.

In a CBA, the costs and benefits (effects) of a project are expressed in monetary terms. Costs can be subtracted from the benefits, the result of which will indicate e.g. whether the pilot project or a follow-on project would be commercially viable. CBA should be selected if:

- all important benefits and costs are known and can be expressed in monetary terms;
- stakeholders emphasise economic criteria;
- an assessment of commercial viability or profitability is required.

CEA focuses on individual indicators of benefits, which do not have to be expressed in monetary terms. The aim is to rank alternatives in terms of benefits per unit of cost. CEA should be selected if:

- several project alternatives or design options are available;
- valuation of effects is uncertain, but stakeholders still emphasise cost criteria;
- an *absolute* evaluation of the value/profitability of a project or transport solution is not required;
- few categories of impact/benefit are critical to the project assessment.

CBA and CEA can be:
- financial;
- socio-economic.

Both CBA and CEA may focus on financial indicators (such as costs and profitability to the operator) or wider socio-economic impacts. In the case of clean vehicle projects, an environmental evaluation will almost invariably be required by at least one stakeholder group. For example, CEA may be used to rank vehicle technologies in terms of NO_x or PM emissions reduction per unit of lifetime operating costs. Full CBA would require the aggregate impact of all emitted pollutants (tailpipe and vehicle/fuel life-cycle) to be estimated in terms of their external costs (to human health, buildings, crops etc.).

Non-monetary evaluation methods

Multi-criteria analysis

MCA methods are designed to take into consideration the multiple impacts of a project in a balanced manner, especially where one or more impacts can only be expressed qualitatively or in non-financial terms. Impacts are weighted depending on their relative importance in terms of meeting the objectives of the project.

How to use MCA

What is common in almost all MCA techniques is the need for the decision maker to determine initially not only the list of alternatives (e.g. projects or design options) to be evaluated, but also the evaluation criteria (or indicators) that will be taken into account for that purpose. The performance of all alternatives will be measured against each of these criteria either on a physical or on an artificial scale, depending on the method selected. The majority of MCA techniques also require the decision-maker to rank or weight the evaluation criteria in order of their importance, either qualitatively or quantitatively. The output of an MCA technique may be a global ranking of alternative projects relative to their performances, or a group of acceptable projects, or pair-wise comparisons of alternatives.

MCA methods have the following advantages:

MCA methods can handle a wide range of impacts.

- They are able to take account of an entire range of differing yet relevant impacts, monetary and non-monetary, quantitative and qualitative, economic and environmental.
- The methods work on the basis of making a preference decision, so the overall most attractive alternative becomes obvious.

The main limitation of multi-criteria evaluation stems from the fact that no one alternative can optimise all the impacts at the same time. The decision-maker must therefore find compromise solutions. For example, a decision between whether to prioritise economic or environmental impacts may need to be made when both are considered important.

MCA methods require agreement on the weighting of criteria.

The outcome of MCA will depend on the weights attached to the evaluation criteria. These weights will vary between stakeholders, reflecting their different priorities and perspectives. Therefore, in any application of MCA, the project manager must decide on how to capture these differences – possibly by round-table discussion to agree a common set of weights, or by repeating the analysis with different weights to see how the overall decision would be affected.

Example: “UTOPIA Evaluation Tree Methodology”

Within the UTOPIA project that produced the current Guidelines, a software tool was developed to help assess the results of clean vehicle projects. The tool provides multi-criteria decision support, based on factors such as those given in Table 3 above. The factors are structured in a hierarchy of branches and sub-branches, and weighting factors can be attached to each branch. The whole approach has been implemented in a commercially available software tool (see http://www.intelmark.fr).

UTOPIA used the methodology both as a device for capturing stakeholder views on project impacts and their relative importance (through structured interviews), and as a means of identifying the critical lessons from a comparison across projects.

Goal-achievement matrix

The goal-achievement matrix evaluates alternative options within a matrix format on the basis of how well each achieves a set of pre-determined goals or objectives. For example, the method gives a potential decision-maker the opportunity to select, from a series of alternative projects, the most appropriate one for implementation, in terms of each project’s rate of success in the pre-defined goals. As this method has evolved from cost-benefit methods, the estimation of costs and benefits is central to the method. However, both costs and benefits are defined in terms of goal achievement rather than in monetary terms.

GAM is less common than MCA, CBA and CEA, and is not considered further in these Guidelines.

Choice of evaluation methods during the project lifecycle

The various evaluation methods can play a role at several stages during a project lifecycle, namely:

1. *Before the project is approved*: In determining the need to conduct a pilot, CBA can identify whether a project will be financially profitable or beneficial to society. CEA answers the question which alternative (transport solution or project option) is likely to be the most effective to achieve a certain goal at least cost. MCA helps decision-makers to take account of a broad range of criteria and stakeholder perspectives, and allows qualitative issues to be brought into consideration.
2. *Evaluation of the project design*: Prior to implementation, CBA answers the question whether a project design is expected to be profitable. If there are several alternatives for the detailed technological design, a CEA can show which alternative will deliver the greatest benefit for one or two key indicators, while MCA will rank alternatives against a wider range of criteria.
3. *Evaluation of the project results:* CBA gives guidance on whether the project has been "successful" in financial or socio-economic terms (but only for monetary indicators). CEA allows the project to be compared with other means of achieving specific impacts. MCA provides a structured means of taking all the project impacts and stakeholder views into consideration,

It is recommended that only suitably experienced staff should apply the CBA, CEA and MCA techniques.

Advantages, disadvantages and limitations

CBA has the following advantages:

- Expression of effects in monetary terms can provide an objective weighting system for aggregation of effects across several impact categories (such as CO_2, NO_x, PM and noise).
- Decision-makers may respond more favourably to monetary assessments of financial profitability.
- Calculation of lifecycle environmental costs allows, for example, the impacts of electricity generation for electric vehicles to be compared with the effects of urban tailpipe emissions from diesel vehicles.

CEA has the following advantages:

- Not all benefits have to be expressed in monetary terms.
- CEA is less demanding and therefore more practical than CBA and MCA if time and funds for the appraisal are limited.

MCA has the following advantages:

- A wide range of impacts can be assessed, including qualitative indicators. This is particularly appropriate for project objectives concerned with *learning* about transport solutions.
- Financial indicators are not favoured merely because they are relatively easy to obtain and quantify.
- Differences in the views of stakeholders on the relative importance of various impacts can be taken into account.

The disadvantages of CBA include:

- Most effects must be expressed in monetary terms. This is often controversial or not possible, especially in the case of socio-economic and environmental impacts.
- It is a tool to measure efficiency, but decision-makers may have a range of other objectives (such as social equity and public acceptance) that have nothing to do with efficiency.
- Many cleaner vehicle projects are not intended to be financially viable. Rather their main objective is learning, or market stimulation, or technology testing.

CEA's disadvantages are:

- It is applicable only if several project alternatives are available.
- It provides only a ranking of alternatives rather than a recommendation whether a project is worthwhile in isolation (i.e. benefits outweigh costs).
- A CEA focused on effect-maximisation looks at a *single* dimension, such as the reduction in particulate emissions. This implies that the possibility of using CEA effectively depends on the possibility of defining target or threshold values along one or more key dimensions. If more than one goal is pursued they must also be weighed against each other, requiring a multi-criteria analysis.

MCA's disadvantages are:

- It requires clarity on the relevant indicators and their relative importance in the context of the project. This may require lengthy negotiation with stakeholders (but with the side-benefit of surfacing differences in perspective).
- The weighting of criteria is subjective and specific to the project, which makes comparison between cities ambiguous.

Based on project experiences from across Europe, MCA appears to be the most flexible method for evaluating the results of a project and for identifying the most appropriate transport solution for a city. CEA may have a particular role in assessing options for the project design. CBA is valuable where commercial viability or the socio-economic cost advantages of transport technologies/solutions are being studied.

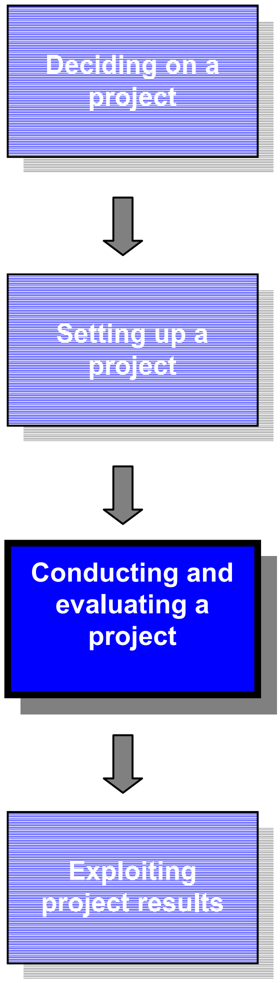
Summary of good practice

Good practice

Recommended good practice for project evaluation is as follows:

- Develop the evaluation strategy as an integral part of the project design from the start.
- Check that the evaluation will deliver the *essential* measurements and indicators to prove whether or not the project objectives have been achieved, particularly where budget constraints on the evaluation effort are tight.
- Check what data collection will be needed at the start of the project *before* the new transport solution is piloted.
- Check what is needed to facilitate cross-city comparison (especially where this is a requirement of funding agencies).
- Define an adequate range of impacts and indicators to address the range of stakeholder interests.
- Within cost limits, collect experiences from those involved in the project, as well as measuring quantitative indicators. Review the data while the project is running.
- Note the collected good practice for vehicle energy and emissions measurements given earlier in this Section.
- Use multi-criteria analysis for the overall project evaluation with stakeholder participation. Supplement this with cost-benefit analysis for economic evaluation and cost-effectiveness analysis for screening options for the project design.

Section 4. Conducting and evaluating a project



In this Section:
- What are the critical success factors in managing this sort of project?
- How can I reduce the risk of failure?

4.1 What are the challenges for the project manager?

The main issues

How should the process of project implementation be managed? What are the critical parameters to be managed?

What are the key actions to reduce risk and increase the chances of success?

Getting on with project implementation

Once the project has been designed and stakeholders are happy that the estimated impacts look promising, the project team can implement the project, conduct the data collection exercise and derive the 'real' impacts.

This Section outlines some of the key activities of the project team. Section 4.2 describes specifically the data measurement and evaluation task.

Management planning

The detailed design of the project should include:

- The definition of a set of tasks to be performed, including their technical description, financial and other resources, duration and organisational responsibilities.
- A detailed timetable for the tasks and an overview of their interactions.
- A plan for overall co-ordination, including a mechanism and schedule for checking the progress of the project.
- A plan for interactions with stakeholders.
- A risk management plan and an environmental management plan.

This is described in more detail in Section 3 of these Guidelines.

The plans should be consistent with the project management and Quality Assurance procedures of the host organisation. If appropriate, a Quality Plan may be prepared for the project, based on the requirements of ISO9000.

Project implementation tasks

A number of tasks are common to any implementation of a pilot or demonstration project:

- Appoint a named project co-ordinator for the entire demonstration project, and individual site managers if appropriate.
- Establish a management team and establish quality control, risk and environmental management, reporting and resource control tools.
- Create or formalise the network of stakeholders. Ensure that all project partners are willing to collaborate actively and play their respective roles. This is crucial. One approach is to ask each partner to formulate their own responsibilities and vision of the project share that belongs to them. This tests their commitment and understanding of the common task.
- Procure and install vehicles, infrastructure, equipment and computer hardware/software. It is essential to satisfy the required technical specifications, time schedule and costs.
- Co-ordinate the different technical tasks within the demonstration. In particular, establish appropriate communication facilities and integrate the selected technologies. Again, the decisive factors here are satisfying the required technical specifications, time schedule and actual costs. Communications across the project team should be encouraged, and not just via the project managers.
- Involve the evaluation team in monitoring the project implementation and start the verification process to ensure quality results (regular monitoring of progress; identifying needs for necessary modifications of the project design over time; regular reporting to the project co-ordinator).

Setting up a project:

- name the hands-on manager;
- form a team;
- set up quality control
- build the network of stakeholders;
- install vehicles, infrastructure and equipment;
- co-ordinate the demonstration tasks;
- start verification and evaluation.

There is always a big dilemma between what ideally *should* be done and what *can* be done with the available resources. The solution to this problem strongly depends on the local situation and the priorities coming from the defined objectives.

The role of the manager in complex projects

Projects that are complex in terms of their number of sites, partners and active stakeholders require the manager to focus on key actions and delegate other tasks.

The project manager should have a firm grip on resources, schedules, progress and communications with external organisations (particularly financial sponsors) on a project level. But it is important to keep an open communication *within* the project, with information being widely shared.

For example, in multi-city projects, a *dissemination* monopoly is advisable only where the project as a whole is concerned. Local and national relationships of individual partners are usually much stronger than those of the project co-ordinator, who should only ensure that local communications are in line with the general project dissemination.

Similarly, any project manager should aim to identify in the course of the project those partners with superior technical expertise and extraordinary commitment to the project goals, and stimulate their contribution (e.g. by voluntary assignment of special tasks). This core group will usually generate additional momentum and discussion (which of course needs to be moderated by the project manager).

In large projects, the manager should take great care to avoid becoming a bottleneck by claiming or accepting too many tasks at once. Usually, a project manager should be content to supervise and steer the project, and personally maintain communications with partners, sponsors and other stakeholders. Detailed work such as task management, evaluation and dissemination should be delegated to experts within the team.

Don't panic!

Possibly the most important message for the project manager is DON'T PANIC! Changes will happen in a dynamic world over the course of a multi-year project; and any project manager should not shy away from implementing vital or substantially beneficial modification. Equally though, the manager should enforce partner compliance with the original contract with funding agencies where changes are unnecessary or a result of complacency.

If need be, the project manager should be ready at any time to appear on site in person, possibly accompanied by a suitable expert, to check and remedy problems on the spot.

Reporting

To obtain up-to-date and concise feedback in the implementation stage of a project, appropriate procedures and responsibilities must be defined:

Regular reporting and review is essential.

- Project operators should report any difficulties in the project design to the management and evaluation team (e.g. concerning the implementation of the design, data collection, time schedule and resource issues).
- The evaluation team should report regularly to the project co-ordinator concerning the emerging impacts of the project.

Reporting to external audiences will also be required. The project plan is likely to include milestones at which specific reports and assessments are needed. The audience for these documentary outputs should be clearly defined – for example distinguishing reports to project partners, external sponsors and the wider public.

An intermediate report may be essential for decisions on project exploitation.

Experience shows that the *final* report from the project is often *not* the most important. Rather, an intermediate assessment can be critical in allowing decisions on follow-on and exploitation of the results, *before* the end of the project. Such decisions often cannot be left until the final report is issued, because this may create a gap of two or more years between the end of the technical work and the start of some follow-on. This risks a severe loss of momentum and know-how.

See Section 5.2.

On the other hand, the final report may be the key output for other cities that wish to find out about the scale of success and the transferable learning from the project. This is discussed further in Section 5.2.

Monitoring resources

Keeping the demonstration on schedule and within budget will greatly depend on:

- regular monitoring and control of resource usage;
- prompt remedial actions when needed (particularly highlighting resource problems that could affect the achievement of the project objectives).

Verification and fine-tuning

The following activities should be carried out to verify the project's set-up before proceeding to implementation:

- *Operational test of the demonstration*. The appropriate operation of the transport solution must be tested and verified before it is used in data collection activities. It is important to check that all required technical specifications are met by the actual performance of the technology.
- *Fine-tuning*. The project may have to be fine-tuned to satisfy the originally defined technical specifications. A redesign of the demonstration should be considered and modifications applied if clear verification is not possible.

Example: Self-drive electric cars in Martigny

The CityCar project aimed to test an innovative combination of technologies for a self-drive car rental system. Many technical issues had to be resolved. For example, the battery range was 50% less than expected. Therefore in the initial phase the drivers were allowed to use the service free of charge. One result was that the patterns of use were not typical of a commercial service, with the vehicles being used for excessive lengths of time. So the evaluation of market reactions, when users had to pay for the service, could only begin after the period of technical experimentation.

Interaction with stakeholders

Close links with stakeholders have been critical in many projects.

Many projects have reported that close partnership between stakeholders has been a critical success factor for project management. Links between the vehicle operator, fuel supplier, vehicle supplier and local authority have been particularly crucial. Good links with national funding programmes have also been important.

The creation of a steering committee with stakeholder representatives has proved a common way of ensuring regular interaction with the project management.

Communications

Experience suggests that major publicity to external audiences is best delayed until the technical implementation is working well and some first results are available. However, at a *local* level, early publicity has proved useful – to explain what is going on, to justify the use of public funds, to warn about possible disruptions to traffic and services, and to explain visible problems as they arise. A regular article in local newspapers has proved successful in this respect.

It is important that the media keep on being positive, even if some adverse experiences occur. Positive issues need to be promoted continually, particularly to counter any negative headlines.

Risk management and environmental management

See risk management planning in Section 3.1.

A risk management plan should have been set up during the design phase (see Section 3.1). This should define when and how smaller "risk reviews" will be carried out at intermediate points during the project.

Intermediate reviews differ from the major risk assessment stages in that they tend to be reviews of progress against the risk management plan. For example, during each major project meeting, some time may be allocated to the discussion of:

- the status of risks highlighted in the last major assessment – those that did and did not occur, and those that are no longer of concern;
- the status of any specific risk management actions that are scheduled to be taking place;
- new or emerging risk areas to be added;
- new risk management actions to be put in place.

Project environmental management

Good practice similarly calls for environmental management to be included in the project planning. During the project, regular review meetings should include reporting on environmental issues. Key performance indicators (e.g. noise complaints, fuel consumption) can provide an overview, leading to an assessment of the need for corrective action. This may include the auditing of contractor activities.

Summary of good practice

The following aspects of project management are critical to success, based on the experience of other similar projects:

- Defining specific milestones for progress monitoring.
- Keeping the management structure simple and light, with well-defined responsibilities, so that the managers can adapt quickly to unforeseen situations.
- Evaluating the results progressively as the project develops, so that decisions on follow-on actions can be taken during the course of the project.
- Monitoring and solving technical problems efficiently, especially in the early stages of project implementation.
- Creating a strategy for managing the information gathered in the project, to allow easy exchange within the project team but controlled release of overall project findings to a wider audience.
- Communication and dissemination of information, based on a defined marketing strategy.

Good practice

Management success factors:
- milestone planning;
- simple structure;
- progressive evaluation;
- problem solving;
- information management;
- communication.

Example: Problem solving with the self-drive electric cars in Martigny

At the outset, the CityCar project intended to capture data on the level of battery charge in each car throughout the day, and transfer it to the central management system. However, the quantity of data proved too large for frequent transmission. On the other hand, experience showed that the vehicles carried sufficient electrical charge to cope with daily demand. Therefore the project took a flexible approach, and chose not to check the vehicle charge at all.

4.2 What are the challenges for the evaluation team?

In this Section:
- What are the critical factors in evaluating this sort of project?
- How do I show success against my objectives?

The main issues

How should the process of project evaluation be managed? What are the critical parameters to be measured and evaluated?

What are the key actions to determine and demonstrate the "success" of the project?

Ex-post evaluation

The third and final of the three phases of evaluation is the *ex-post evaluation*. The intermediate and final results of the project will now be evaluated in terms of:

- What changes have occurred in the project since the design stage, what have been the effects, and what are the consequences for the demonstrated transport solution?
- What have been the actual impacts i.e. transport solution performance, socio-economic effects and wider learning?
- How far has the project achieved its objectives?
- What are the implications for the future?

Goals of the ex-post evaluation:
- review project implementation;
- assess impacts;
- evaluate against objectives;
- assess implications for the future.

The outcome of the ex-post evaluation will influence any decision on follow-up, e.g. whether or not to proceed to full-scale implementation. In order to ensure a smooth transition, this decision may be made perhaps one year before the initial project ends. So good intermediate results are needed to justify market introduction, while the final results may attract less interest.

"With-without" comparison

The ex-post assessment compares indicators of the "before" and "after" situations. However, the real goal is to assess the difference between the transport and environmental outcomes "with" and "without" the project (or, if relevant to the project objectives, the scaled-up transport solution).

It is also instructive to compare the ex-post results with those of the ex-ante evaluation in order to determine how accurate were the assumptions made at the ex-ante stage. This can help to identify the most critical factors relevant to any decision on a follow-up or scale-up of the project.

Project risk assessment

When the results of the project have been measured, risk assessment forms one element of the evaluation work.

This is the third in-depth assessment of risk during the project lifecycle. It is distinct from the earlier risk activities, in that it focuses on the outcome rather than the implementation of the project. The objectives are:

Risk management objectives:
- assess uncertainty in results;
- assess risk of decisions based on the results.

- to identify and assess the uncertainty present in the measured results from the project;
- to identify and assess the risk and uncertainty associated with the transfer of the project results into recommendations regarding the wider application of the transport option following the pilot phase.

The first objective "looks back", ensuring that the uncertainty in the results is properly acknowledged. There are two issues to be highlighted:

- the statistical uncertainties in the measured and calculated data. These feed directly into the overall evaluation methods (CBA, MCA etc.).
- the assumptions made in the data analysis which, if not correct, represent a risk that the analysis is misleading. These assumptions must be stated as part of the results.

The second objective takes the thinking one stage further. It asks whether any of these uncertainties or assumptions materially affect the conclusions being reached, particularly regarding the impacts which might be experienced if the pilot were implemented on a larger scale or in another city. Again, any key caveats or conditions under which the results would not be valid must be identified.

This is only an initial consideration of the transferability issue, which is addressed in more detail in the post-project review (see Section 5.1). However, it is worth beginning the discussion in this main evaluation phase to collect the perspectives of the data analysts and others "close" to the project itself. These people may have insights that are not present among those responsible (later on) for deciding whether the project results justify wider implementation of the option.

Issues for the ex-post evaluation

The questions that have to be addressed during the ex-post phase will now be examined in more detail.

Did the project meet its objectives?

The overriding question to be asked about a project is whether it has met its objectives that were defined at the outset. The answer to this question will be based on:

- the successful implementation of the project;
- the results achieved in each of the evaluation areas;
- how easily the results can be drawn together to make recommendations, both for potential wider implementation of the transport solution and the conduct of similar projects.

Has the project been conducted as planned?

One issue here is whether the design of the project has been followed, the costs were as expected, and the operation of the transport solution was as planned. If not, the reasons for changes and the consequences should be assessed.

One of the main roles of the ex-post evaluation is to assess the impacts of the project. In particular the behaviour of the users and their expressed opinions (gathered, for example, by means of a survey) regarding the project should be taken into account.

What are the impacts of the project?

The evaluation also provides the opportunity to compare the results with the assumptions made in the ex-ante evaluation. For example, although the assumption was that within a range of five kilometres there were 5,000 potential customers, the number may actually have been the lower. Hence, project usage and income may have been less than expected. The evaluation should address the question of why the initial assumptions were wrong. Previous projects have found that the following assumptions have often proved inaccurate:

Do the outcomes match the assumptions?

- reliability of the technology;
- vehicle range, fuel consumption and emissions;
- types of users and their travel patterns;
- technology acceptance.

In addition, the ex-post evaluation should focus on learning lessons for the future, both for conducting similar projects and for full-scale implementation of the transport solution. Are the results representative of large-scale introduction? Were the users during the project different to average users? Were the results strongly influenced by unique city characteristics? These lessons can be drawn from the opinions of the users and other actors and the actual impacts of the project.

What lessons can you learn?

Data collection and management requires a lot of time and money. Data should be objective and unambiguous and be carefully targeted on providing the necessary information to meet the project objectives and test key hypotheses. In practice, a trade-off has to be made between the cost of data collection and the quality of the data.

Experience with data collection in clean vehicle projects has shown that:

- Structured interviews are needed to explore what can be learnt from the project, as a supplement to quantitative measurements. These should involve a range of perspectives (e.g. drivers, workshop staff, managers and passengers).
- Data collection should be arranged to minimise any additional burden on operating staff, so that its reliability and completeness can be ensured.

Interviews are needed to supplement quantitative measurements.

Example: Operator experiences with CNG vehicles

The CNG fleet in the London Borough of Merton includes vans and garbage trucks. The van drivers complained about the increased cab temperature due to heat from the engine and a lack of power. On the other hand, the garbage truck was favoured over diesel – the staff found it quieter and the emissions less noxious when working at the rear of the vehicle.

Example: Evaluation of the Mendrisio EV fleet test

In the Mendrisio project, three main evaluation issues were defined at the start based on the defined objectives:

- evaluation of the promotional measures,
- investigation of the mobility patterns of EV drivers, and
- assessment of energy consumption and environmental impacts.

For the investigation of mobility patterns, the method had to be changed. Originally it was planned to compare the patterns of EV users with non-users. After two years' experience it was obvious that external conditions such as changing job or a person leaving the household have more influence on mobility patterns than the availability of an EV. In the new method, each EV driver records in all their trips (not only the ones with the EV) in a mobility journal, before getting the LEV and one year after. In addition the yearly distances driven by all vehicles in the household are recorded. Both sets of data are analysed together with the test drivers by interview concerning external conditions influencing the results. These methods don't lead to quantitative results but at least give a good insight into the patterns of use of an EV.

User-reported energy consumption was significantly higher than the values measured in laboratory tests. (This was not surprising since controlled tests never can replicate real-life conditions.) In order to analyse the differences, a data logger had to be installed in selected vehicles. This logger collects each second various vehicle data such as speed, acceleration, altitude, temperature, battery charging energy, regenerative energy and energy consumption.

Typical problems in evaluation

Problems that commonly occur in the evaluation process are:

- *Difficulties in providing clear evidence of modal switching*. This requires the project to be of adequate scale for a statistically significant shift to occur. It also requires surveys of travel behaviour both before and after the implementation of the project.
- *Ambiguities in identifying outcomes that are transferable to other cities*. One solution here is to look at qualitative changes in behaviour and user perceptions, rather than focusing on aggregate numerical indicators.
- *Statistical uncertainty over the performance of vehicles* (e.g. emissions, reliability) owing to the small numbers of vehicles tested. This is rather dependent on matching the experimental design to the data needs. For example, more vehicles, duplicate vehicles of the same model, repeat emissions tests and constant test conditions can all contribute to reducing uncertainty.
- *Difficulties in identifying changes in behaviour* (user types, trip purposes, attitudes etc.) that underlie measured changes in demand. This requires detailed user surveys and qualitative techniques.
- *Uncertainty over the extent to which results are representative of real-life*, owing to the limited scale and duration of projects. Again, this is dependent on a good project design. It is also important to assess whether the project participants should be classed as "leading edge" or "average" users.

Impacts to be evaluated

The ex-post evaluation will need to consider the impact categories that were defined prior to implementation (see Section 3.3). Some of these impacts will have been estimated prior to the project. Other impacts (especially in the area of "learning") can only be studied once the pilot implementation has started.

See Section 3.3 on evaluation.

The impacts need to be derived from the measured data and other observations, and then synthesised into a useful framework for final evaluation against the project objectives. For example, a judgement may be required on how well the demonstrated transport solution actually performs in an operational environment. Operators of vehicle fleets and refuelling infrastructure may want to know whether they are likely to receive a return on their investments, either from this project or a future implementation. Local authorities may want a quantitative estimate of the effects on congestion and air quality – although these parameters are difficult to measure for a small-scale project, and scaling-up effects for a large-scale implementation are difficult to predict.

There is no fundamental difference in the evaluation of impacts within the different phases of evaluation. However, the available data at the ex-post stage will be of a higher quality and level of detail.

Environmental data will ideally be in quantitative form and can be evaluated in terms of emissions, effects on air quality, impacts (e.g. on human health) and the monetary value of those impacts. The choice between these indicators should have been decided in the evaluation strategy, in accordance with project objectives.

Evaluation of user perceptions

In the ex-post evaluation phase, the impact of the project on *perceptions* of safety and public acceptance can now be assessed. Much of the information will be qualitative, having been collected by interviews, questionnaires and other market research techniques. There may be significant differences between ex-ante and ex-post perceptions when dealing with innovative technologies and transport solutions with which many stakeholders have had no prior experience.

What are the methods for impact evaluation?

The output of the data processing will be the calculated indicators. These are then fed into the evaluation process. As highlighted in Section 3.3, a range of methods may be used to evaluate the extent to which a project has met its objectives, or the performance of the demonstrated transport solution. These include cost-benefit analysis (CBA), cost-effectiveness analysis (CEA), multi-criteria analysis (MCA) and goal-achievement matrices (GAM).

The choice of what to do with the output from the impact calculation will depend on the objectives set at the beginning of the project. Whatever the method used, it is likely that the conclusions will contain some level of ambiguity. Stakeholder participation will be important at this stage.

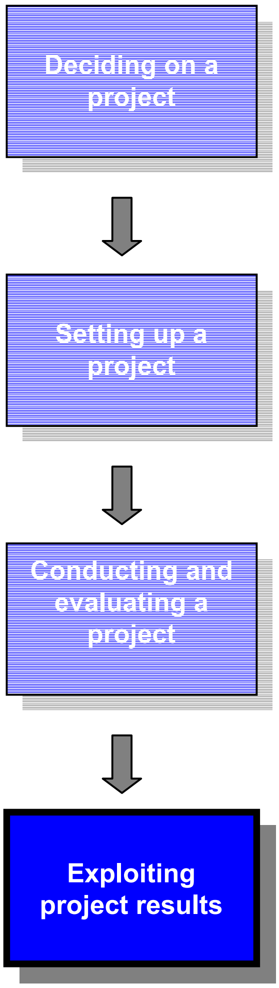
Summary of good practice

Good practice

Experience from previous projects suggests the following elements of good practice for the ex-post evaluation:

- Be prepared to change the data collection procedures during the project.
- Always focus on matching the evaluation outputs to the project objectives, and identify the benefits per stakeholder group where possible.
- Ensure that the same impacts are determined using consistent methods at different test sites.
- Record the factors specific to the city and the operating context that have an influence on the results.
- Compare ex-post results with equivalent ex-ante estimates, and investigate the reasons for significant differences.
- Identify the differences in outcomes “with” and “without” the project.
- Identify and assess the uncertainty present in the measured results from the project.
- Develop interim/preliminary results that are useful for decision-making on exploitation and follow-on.
- Identify and assess the risk and uncertainty associated with the transfer of conclusions into recommendations regarding the wider application of the transport solution following the project.

Section 5.
Exploiting project results



In this Section:
- How do I assess the scale-up potential?
- What can I learn from my results?

5.1 Learning from the project

The main issues

From my own city's perspective, how do I assess the implications for larger-scale implementation of this transport solution?

What can I learn from my results? What has been learnt from previous projects?

Should I scale up this solution in my city?

What learning is possible?

Many cleaner vehicle projects include a strong focus on "learning" within their objectives. Areas of learning include:

- the financial implications of switching to new technologies;
- the performance of technologies in real life and how to adapt operations to use them effectively;
- opportunities and barriers to fit the transport solution into the existing transport system;
- infrastructure requirements;
- the performance of policy measures in real life;
- new requirements for policies and vehicle programmes;
- stakeholder and user acceptance of (or opposition to) innovative transport solutions and policy measures;
- project level changes in user behaviour (e.g. by "leading edge" users);
- more general changes in patterns of mobility and modal choice (e.g. that might be expected from "average" users);
- changes in stakeholder interactions and institutional arrangements;
- changes in expectations on the "problem solving potential" of new technologies and transport solutions.

The project team should highlight new and surprising findings.

Often there will be "surprising" findings, given that a main purpose of pilot and demonstration projects is to reduce uncertainty in the face of the risks of large-scale implementation. The project team should be able to point to new knowledge resulting from the project.

Whenever learning is a major objective of a project or programme, it is important to monitor and evaluate a wide range of factors. An example of good practice is the Mendrisio electric vehicle project, where the evaluation strategy included technical test procedures, cost and market analyses, and assessment of the effects on stakeholder networks.

Post-project review

The ex-post evaluation leads into a post-project review of the overall successes of the project, the lessons learnt, implications for the future and for other cities. This needs to be done in discussion with stakeholders, and the review findings need to be communicated and disseminated to all those who could benefit.

Review questions

The questions to be covered in the review are:

- Were the expected impacts achieved, at the expected level? What other unexpected impacts were observed?
- To what extent have the objectives, formal and informal, been realised?
- More generally, how do the results contribute to solving the original problem?
- What was learnt in this project about the costs and benefits of the transport solution and how best to introduce and use it?
- Are the results consistent with those from similar projects? If not, why not?
- How might the project have had a greater impact? What would you do differently next time?
- What lessons can be learnt from the risk management and environmental management activities?

Expectations of programme sponsors

The learning can be separated into two categories: lessons to be applied by the stakeholders in this project/city, and more general lessons for other cities. National and European sponsors of the project will expect to be provided with output in the second category, covering such topics as:

- the cost-effectiveness of alternative technologies and non-technical measures in reducing environmental impacts and improving urban conditions;
- the “real-life” costs and operating performance of new transport technologies and concepts;
- critical success factors for such projects, and good practice recommendations;
- the marketability of the transport solution in a move towards commercial operation and scale-up;
- indications of the responses of leading edge and average users;
- the transferability of the findings to other settings;
- the potential for fighting urban congestion;
- the potential for enhancing intermodal and multi-modal transport (e.g. linking the private car and the use of public transport);
- options for improving the fit between the features of a new transport solution, its technology, and their acceptability to all stakeholders;
- the marketing messages and methods that seem to be the most effective in reaching and influencing the various stakeholders;
- the extent to which the project justified the use of public funds.

Post-project risk management

At this stage, a risk assessment should be made to provide a final overall picture of the "evaluation risk" (i.e. the risk and uncertainty present in the results and conclusions). This can then be taken forward into any wider programme or strategic planning, where decisions will be taken on the basis of the pilot project.

Identify the uncertainty in the conclusions, and the risks of acting on them.

Two messages must be developed, with supporting evidence, and passed forward from the risk work:

- Firstly, in interpreting the results and conclusions of the pilot, future decision-makers should take full account of any caveats regarding the uncertainty present in those results.
- Secondly, in any full-scale implementation of the scheme tested by the pilot project, the risks associated with transferring the pilot results to full scale should be considered.

This risk activity also provides the opportunity to link the pilot project risk work into any risk management process instituted in the procedures and guidelines for the wider programme or business context in which the project took place.

The importance of 'broad learning'

Learning from demonstration projects can take place on a variety of aspects. The list below is not meant to be comprehensive but to illustrate the range of issues that may be relevant, depending on the project objectives and scope:

- project management issues;
- technical issues;
- financial issues;
- user requirements;
- (influencing) stakeholder perceptions;
- influence of higher level policies and stakeholder strategies.

Examples of learning on some of these issues are presented below.

Example: Learning about user requirements

The Praxitèle project found that self-service is an important part of the self-drive concept for electric rental cars. Demand for cars increased sharply after operator-assisted hiring was replaced by 24h/24h unattended hiring. This particularly suited private individuals, whereas companies preferred a booking service to provide a guarantee of vehicle availability.

Example: Learning about (influencing) stakeholder perceptions

In the French Government's CNG bus trials, interviews with bus passengers at different test sites showed varying perceptions of the new technology. Two actions were found to correlate with high awareness of the perceived benefits of the buses (low pollution, low noise, comfortable and modern):

- on-bus advertising (distinctive livery, information inside and outside the bus to link gas fuelling with cleaner air);
- a significant jump in the quality of the buses simultaneous with the change in fuel.

The CNG buses had been introduced one year earlier at one site. Comparison with the other sites revealed a decrease in passenger awareness over time. This points to a need for periodic refreshing of the marketing of clean buses.

Residents and tradesmen showed even greater appreciation of the low pollution and noise than the passengers, influenced by the visual comparison between the different types of buses moving past their doors.

Example: Learning about promoting the acceptance of new vehicles

A demonstration project of 100 electric passenger and light goods vehicles has been operating in Skåne during 1998 and 1999. Initial conclusions are that the acceptance of electric vehicles can be promoted in the following ways:

- Raising public awareness of electric vehicles and their impact on the environment relative to traditional vehicles.
- Ensuring user awareness of the capacity and limitations of the EV.
- Information and communication with people in charge of decisions that influence the use of cleaner vehicles.
- Education of the user of EV. Use of the EV in suitable applications. Advice on driving behaviour that is efficient and safe (e.g. taking into account the low noise of the vehicle).
- The provision of permanent charging places where the EV can be charged during the night or when parked.
- The supply of different types of car and truck to satisfy different user needs.
- Ensuring good support from manufacturers and suppliers.

The breadth of the examples above illustrates that it is often misleading to judge the project as a whole as either a success or a failure. It is more instructive, to the project stakeholders as well as potential interested parties elsewhere, to evaluate a variety of individual aspects and be specific on what has been learned on each of these aspects. Findings on all these aspects can then contribute to the emergence of promising courses of action towards a more sustainable transport system. Sadly, a number of projects have failed to meet original high expectations, and have disappeared from view with little reporting. This means that problems and barriers have not been diagnosed for future action.

Any project can be successful in helping others to learn.

Another lesson from previous demonstration projects is that they should be treated as requiring a "learning space". This should be somewhat protected from the harsh reality outside (e.g. in terms of strict economic selection and evaluation criteria), but nevertheless subjected to mechanisms that exert pressure for improvement, similar to market forces. As part of this, a planned opening up of the demonstration project to market competition is a useful strategy. In other words, learning should also be understood as a process that makes the demonstrated technology fit for the market.

Expectations on the "problem solving potential" of new technologies and transport solutions

Stakeholders have expectations about the potential of various new vehicle technologies and transport solutions. They are inspired by these expectations in their subsequent actions to promote or ignore such innovations. If an expectation becomes widely shared by different actors, market change rapidly becomes viable.

Three characteristics of expectations are important:

- *robustness:* an expectation is more robust when it is shared by a larger variety and number of relevant actors;
- *quality:* an expectation is of high quality when it is supported by ongoing developments (e.g. demonstrations of innovations, co-operation between important actors);
- *specificity:* a specific expectation (for example, "electric cars will be suited to commercial traffic in cities") will be realised more easily than an ill-defined one (for example, "the future belongs to electric vehicles").

Demonstration projects change expectations.

Pilot and demonstration projects can change stakeholder and public expectations of the contribution of innovative transport solutions in tackling transport problems. If various stakeholders co-operate in a project and jointly evaluate its results, a project can help to make their expectations more robust. The tangible results help to raise the quality of the expectations. Furthermore, by targeting a specific application or user group, the project can also help to make expectations more specific.

Raising expectations is crucial in overcoming the "conservatism" inherent in the transport system, the vehicle/fuel supply industries and people's purchasing and travel behaviour. Larger and more radical projects have an important role to play here, and communication of the results is of prime importance. By increasing the familiarity of different actors with new vehicles and fuels, and expanding the market demand, the confidence of all stakeholders in the longer-term viability of the demonstrated solution can be raised. National and European programme managers will have a particular interest in this area.

Stakeholder expectations

This implies that the project team needs to evaluate to what extent the findings of the project have changed the vision and expectations of the various stakeholders. The following items should be addressed:

- Have stakeholders changed their opinion on the problem solving potential of the transport solution? Who has, and who has not?
- On what dimensions do stakeholders think the prospects have improved or deteriorated: technical performance; cost-effectiveness; possibility to satisfy infrastructure requirements; fitting user needs;

emissions; energy consumption; reducing congestion; improving urban liveability and accessibility; overcoming political barriers?

- Have expectations become more *robust*?
- Has the *quality* of expectations been raised?
- Have expectations become more *specific*?

Quite commonly, expectations do not change radically but gradually. This means that stakeholders develop a more refined view on the conditions and extent to which a transport solution can help to solve specific problems.

Example: Expectations of technological change

During the Mendrisio EV fleet test, the appearance of EVs with new battery technology (nickel/ metal hydride) had a positive effect, insofar as it attracted much positive attention. On the other hand these vehicles had a negative aspect, too: As these vehicles set a new standard for EV performance but couldn't be supplied to meet the demand, people started to hesitate to buy other vehicles and waited for similar products.

Another critical point is that there is little evidence that a clean vehicle technology *in itself* is able to stimulate users to change their travel behaviour. Modal shift only seems to happen when other measures are taken at the same time, either to discourage people from using their current means of transport (e.g. the car) or to encourage them to use an alternative service (e.g. attractive public transport). This has to be considered in any assessment of project impacts.

How do the results relate to the original problem?

It is instructive to examine the project results against the original problem as well as the defined objectives. Both the perceptions of the problem and the agreed objectives may have changed in the course of the project, especially during long projects. Questions to ask include:

Relate the project results to the original transport problem definition.

- Did the project achieve impacts in the targeted areas, and were there additional impacts in other unforeseen areas?
- Were the impacts achieved at the *level* originally anticipated?
- Have other potential solutions emerged during the project period which appear more promising, either in terms of problem solving potential or cost-effectiveness?
- Do the results of the project suggest a full-scale implementation would address the original problem?

Are the results consistent with other projects addressing the same problem?

Because the findings of a single project are necessarily limited in scope and dependent on the local context, it is useful to compare them with those of others which have addressed similar problems. This process can boost confidence in the results, if they reflect those of other projects, or

Compare results with those from similar projects.

alternatively call into question why the results differ from those of similar projects.

If results are not consistent, it can be worth determining why the inconsistencies exist. The comparison projects may differ in detail, they may have been established to address different objectives, specific stakeholders may have played a different role, and peculiar local circumstances may have influenced the results.

Where can you find projects suitable for comparison?

There is a range of sources to obtain comparable project findings. Since many projects have Web sites, a good start can be made on the Internet. National and European programme managers are also rich in contacts. This can be followed up by direct contacts with project managers in other locations. Direct interaction or visits will probably give the most useful results, as they will allow the project team to retrieve a lot of detailed information that is often not found in written reports and to relate the experience obtained elsewhere to the local situation. Some exchange of information may be essential to provide an incentive for co-operation.

Visits to other projects allow the most detailed comparison.

Should you proceed to full-scale implementation?

Many pilot and demonstration projects in some way address the question “Should I proceed to full-scale implementation”. This question may be asked by a national policy-maker seeking to support suitable technologies, vehicle and fuel suppliers facing capacity investment decisions, fleet operators determining their purchasing policy, and local authorities defining their public transport strategy.

Before this question can be answered, the post-project review (see above) must determine whether the project met its objectives, and whether these objectives still reflect the questions surrounding project scale-up.

If none of the objectives have been met, proceeding to full-scale implementation would be inappropriate. This should be an exceptional case, however, especially when care has been taken to define specific learning objectives and collect data on the relevant issues.

If some of the objectives have been met, deciding what to do next can be difficult. It is worth determining whether the most important objectives that relate to the scale-up option have been met, or whether the uncertainties that the pilot project aimed to address can now be resolved using new evidence from elsewhere. After that, a risk analysis will show whether the remaining uncertainties permit scale-up or require further pilot work. In the latter case, a revised project may be appropriate to attempt to address the problem area again.

Scaling up even a successful project carries some risk.

If all the objectives have been met, the decision whether to proceed to full-scale implementation is easier but still not without risk. It should not be assumed automatically that a technology or transport solution that is successful at pilot scale can be scaled up successfully.

Example: Praxitèle EV project

The Praxitèle self-service vehicle rental scheme targeted the eventual use of small (and relatively cheap) electric vehicles for short-range trips. Such vehicles, however, were not available and the project was carried out with quite heavy and expensive vehicles that were available on the market. As the project aimed to investigate user acceptance, the rental scheme was subsidised to the extent that the price for the user was as if such cheap EVs were available. The project demonstrated that there is a market demand for such a transport concept. This result suggests that there is a specific type of market for small and relatively cheap EVs.

Despite this success, however, it is too soon for full-scale implementation because it is unclear how large that market is, and whether this will allow the level of mass production to achieve the desired cost reductions. This needs to be explored further.

Even with a less radical transport solution, it should not be assumed automatically that a technology or solution that is successful at pilot scale can be scaled up successfully. All that the results of the project can do is help stakeholders to be more confident about technology performance, user acceptance and market behaviour at full scale.

Uncertainty in scaling up

Inevitably, there is a certain degree of risk involved in progressing to full-scale implementation. A variety of factors may have the effect that project results are not reproduced when scaling up, such as:

- site location: this may have been a key factor influencing the success of project, but if the characteristics of the specific location cannot be translated into general conditions, it is unlikely that the positive project results will be repeated at full scale;
- the behaviour of innovative actors and (leading edge) users involved in a pilot: this may not be representative of a general population that is less receptive to innovations.

The reverse may also happen, i.e. that scaling up amplifies the results obtained at the pilot level:

- the public awareness raised by demonstration projects may increase the willingness of future users to change their transport behaviour;
- there may be network effects if the project is implemented at full scale. For example, the introduction of a single bus lane and a reduction of road capacity at that section may have limited impact, since cars will probably divert from their regular routes and the travel time gains for the bus are limited. If, however, bus lanes are constructed full-scale as a network, diversions will be much more difficult, while the bus travel time gains are likely to be more substantial. Therefore the impacts on the modal split and congestion are different.

Uncertainties will always remain, but by anticipating them attempts can be made either to facilitate the introduction and/or to get optimal results in terms of transport efficiency and reducing harmful effects. This implies that it is necessary to make a critical analysis of the extent to which the pilot situation represents the full-scale situation. Evaluation of project experience from elsewhere can help in this respect.

Example: LPG buses in Chester

The Chester demonstration of a single LPG bus established a climate in which LPG buses are considered as a viable cleaner alternative to conventional diesel buses. Two out of three major bus operators in Chester now have LPG buses and refuelling facilities, as does another bus operator in the region. A second LPG supplier has become involved.

What is the relative risk of scale-up?

Transport solutions involving clean vehicles can be roughly classified according to their degree of innovation along two dimensions: technology, and change in user behaviour. Each dimension is a continuum, but they can be conveniently illustrated as a bipolar distribution:

		Technology	
		Low innovation	High innovation
User context	Low innovation	e.g. CNG bus substituting for diesel bus	e.g. electric vehicles sold to individuals and companies
	High innovation	e.g. CNG bus combined with park & ride and car restraint measures in city centre e.g. advanced diesel cars offered in a short-term rental service	e.g. electric cars offered in a short-term rental service

In a low/low innovation, the main objective is typically to reduce emissions and fuel use, rather than changing the traffic situation. The evaluation focuses on technical and environmental performance. After a pilot project, the decision to scale up can be taken if the project demonstrates that there are substantial societal benefits and the costs do not appear to be an insurmountable barrier.

If the technological innovation is high (while little change is user behaviour is needed), user acceptance of that technology becomes a criterion for scale up. User acceptance can be evaluated in a rather narrow sense, as the new technology essentially replaces an existing technology and is used in the same manner.

If the user innovation is high and the technology innovation low, for example where substantial modal shift is targeted, the user behaviour has to be evaluated in detail. Because behavioural changes are complex and difficult to understand, it is risky to base a scale-up decision on a single project. However, lessons can be drawn from similar projects that used conventional-fuelled vehicles, and from other clean vehicle projects. This may either give the confidence for scale up, or provide the starting point for follow-on projects to explore certain issues further.

The risks of project scale-up are significantly higher where substantial changes are required in user behaviour.

Finally, if innovation is high for both the technology and the user dimension, the complexity is further increased. Changes on the two dimensions are often inter-dependent, and evaluation is correspondingly difficult. Such projects usually form part of a much longer process to assess the viability of radical solutions to transport problems, and their findings need to be combined with those from other projects.

What policy impacts can be foreseen from the project as conducted?

It is highly unlikely that the results/impacts of an *individual* pilot or demonstration project will have such wide-ranging influence that they instantly lead to an amendment to policy at the European or national level. For instance, positive experience with low emission LPG or CNG buses will not easily lead to a reformulation of European emissions standards to award them a special status. Policy action at a local level may follow, though, depending on the objectives of the project.

Example: Cheshire County Council

Following the successful two-year demonstration of an LPG bus on a Park & Ride service in Chester, Cheshire County Council used the results to justify the introduction of a dual tendering procedure when contracting out for bus services. Tenders for services using LPG buses were requested in parallel with tenders based on diesel vehicles, knowing that LPG is likely to be a more expensive option. Next the Council found the funds to cover the extra costs of LPG (around 10%). Finally they put the case to the decision-makers for LPG (lower emissions), and this was accepted.

Thus the Council circumvented their statutory duty to opt for the cheapest possible tender, and pre-empted the UK Government's recent implementation of a "best value for money" approach to procurement.

Nevertheless, the results of the project, especially if reviewed in conjunction with results from similar and complementary projects, may help to validate policy hypotheses, leading to decisions to initiate, continue or modify policy actions.

Example: Bristol electric bus

The EC CENTAUR project introduced two 5 metre electric buses operating a park & ride service in the city of Bristol. The vehicles and service proved popular, and at peak times capacity problems were experienced. UK legislation prohibits standing passengers on vehicles of this size, and this contributed to the problem. As a result of the project, the UK Government has been requested to re-examine the legislation relating to standing passengers.

What have been identified as critical success factors by previous projects?

Post-project reviews of city initiatives around Europe have highlighted a number of aspects within the overall project life cycle as having been highly influential on the success of clean vehicle projects. These are presented in the Overview section of these Guidelines and summarised here:

- clear objectives agreed by the stakeholders;
- thorough assessment of the most suitable technology;
- identification of user needs and responses;
- the use of proven technologies;
- allowing an initial period for resolving technical problems and fine-tuning vehicle operations;
- adequate financing and project design to meet the objectives;
- talking with those who provide the funds;
- setting up a simple yet effective management structure;
- matching the measurement and evaluation strategy to the needs of the project;
- communicating the vision, plans, results and successes;
- making the project flexible to changes in external conditions and technical risks;
- defining the exploitation strategy or business plan, during the inception phase, for the transition from demonstration phase to the follow-on “market” phase;
- building strong political support;
- good project partner networking.

One or two strong project champions can be identified for most of the successful projects. The champion has particularly played a role in getting the project launched and securing stakeholder commitment. Sometimes the lead responsibility has been passed on to someone with more specific project management skills for the design and implementation stages.

What have been identified as failure factors by previous projects?

Post-project reviews of European projects have also highlighted a number of key factors that have contributed to a relative lack of “success”. These are presented at the start of these Guidelines and summarised here:

- technical problems with vehicles, late delivery and poor technical backup;
- high costs, making cleaner vehicles look distinctly uneconomic;
- premature emphasis on commercial viability;
- premature publicity;
- failure to measure critical indicators for certain project objectives;
- lack of risk analysis and contingency planning;
- departure of the project champion during the project;
- inadequate project duration;
- excessive emphasis on technical aspects in talking to users;
- lack of awareness among the public and policy-makers about local transport problems;
- unrealistic expectations of the interest and ability of vehicle manufacturers and suppliers to provide and support new technologies;
- lack of municipal power to introduce supporting policy measures.

Failure to meet objectives should not be allowed to obscure the learning from a project.

Projects can fail to meet certain objectives, but this does not have to imply a waste of time and money. Good projects yield learning on a range of issues. Furthermore the learning that can be achieved from *adverse* project experiences can yield key insights for the future. For example, the Mendrisio project set targets for the number of electric vehicle sales that were not met. This was not considered as a failure by the organisers though, because a more important goal was to learn about the effectiveness of various support measures that should stimulate the market for electric vehicles.

Example: Bicycle lift, Trondheim

The bicycle lift has proved a great technical success, is accepted by the users, and many hilly cities have expressed an interest in it. However, to date, no other schemes have been implemented. One contributory factor seems to be the lack of evidence of an effect on modal shift. The Trondheim project focused resources into the engineering development, and did not establish a detailed baseline of traffic data and travel behaviour before the lift was introduced. An alternative site might also have offered the chance for greater modal shift.

So the question remains whether the lift is an additional service to an existing population of cyclists, or a measure to increase that population. This is not to say that the Trondheim project is a failure. But it illustrates how a succession of projects may be needed to realise the market potential of an initial technological promise.

Summary of good practice

Good practice

Recommended good practice for learning from the project is as follows:

- The project team and stakeholders should conduct a post-project review.
- The outcome of the review should include a clear statement of the risk and uncertainty present in the results and conclusions from the project.
- The review should aim to cover broader areas of learning as well as evaluating the success of the project in attaining specific objectives. For example, changes in stakeholder expectations of the demonstrated technology/solution should be explored.

5.2 Identifying implications for other cities

In this Section:
- What are the implications for other cities in Europe?
- How can a transfer of experience be achieved?
- How can I contribute to national and European objectives?

The main issues

How might my results facilitate further deployment and scale-up of this solution in other cities?

What communications strategy should I follow?

What outputs do national and European programme managers expect?

Although these Guidelines put much emphasis on learning and the transfer of results to other cities and projects, do not anticipate that this will be easy. Various partners may want to protect commercial details and project know-how, and the generalisation of results to other contexts is always problematic.

Adding value at a national or European level

There is considerable uncertainty about the technical performance and market potential of transport solutions based on new propulsion systems. Pilot projects are often costly. Therefore project sponsors often place great emphasis on adding value at national and European levels, and not just focusing on the local benefits.

National and European sponsors look for inter-site comparison.

This implies that efforts should be made to extract and disseminate the non-site specific learning. Both the positive and the negative findings from the project provide potentially important lessons for others. This is particularly true for projects funded at the European level. The European Commission seeks to add value by funding projects involving several cities across Europe, in preference to choosing single projects or leaving them to national authorities. Inter-site comparison and the provision of results within common frameworks are key elements of this strategy.

Making the results relevant to other cities is also in the *local* interest as it opens up a two-way street: it facilitates gaining information from other sites for comparison with the local findings. In this way the local decision-making on whether and how to scale-up can become better informed.

Therefore the evaluation strategy of a project should consider how it could add value at the European level, for example, by:

- producing transferable results, possibly through comparison of sites within the project, or by partnering with related projects through a European network;
- providing data according to commonly used sets of performance indicators;
- disseminating results to cities across Europe;
- helping to increase awareness of the barriers to certain measures by comparing results with those of other countries with different institutional arrangements;

- identifying barriers that should be tackled at higher levels;
- contributing to the testing of innovative technologies for comparison across a range of locations and circumstances;
- highlighting actions to harmonise standards and regulations across Europe. These include standards for fuel handling technologies and planning regulations for safety of infrastructure.

Nevertheless, a balance will be required between the interests of national and European sponsors and commercial stakeholders. For example, there may be sensitivity over intellectual property rights for new information technologies. Similarly, project managers may not be keen to disclose critical details of their professional skill such as the organisational know-how for a successful project. (In this, the project champion and the hands-on project manager may have different attitudes to dissemination.)

Example: Electric vehicle projects

The CityCar project in Switzerland and the Praxitèle project in France have each developed technologies such as vehicle management systems and contactless smart cards. However the commercial interests of private sector partners prevent a full transfer of experiences between the two projects.

Example: Swedish EV programme

The Swedish Government has sponsored projects involving around 300 electric and hybrid vehicles, mostly cars and light vans. Experience has shown the importance of getting a critical mass of vehicles. Once several municipalities had adopted EV’s, others started to volunteer. Positive press coverage was also important.

Free and designated parking spaces for EV’s were identified as an important supporting policy.

Example: Flemish programme on clean vehicle demonstration

A number of projects with electric, hybrid and natural gas vehicles have been supported in the Flemish region of Belgium. Key lessons are:

- technology reliability should be a major criterion in vehicle choice, since a lot of demonstrations had unexpected technical problems;

- the close involvement of vehicle manufacturers in projects helps to overcome these technical problems;

- people can turn against a technology if misleading expectations are raised about e.g. vehicle reliability.

How do you make your findings transferable?

The Guidelines presented in this document have identified several stages of the project lifecycle where information from other projects can be useful: comparison of alternative transport solutions, ideas for design options, suggestions for good practice based on project experience, quantitative results for cross-checking project impacts. In the same spirit, a project team should consider that others would welcome reciprocal information.

Project characteristics

Details will become more transferable if they provide practical guidance about key factors during the design and implementation phases of the project, as well as the final results. These should include:

- A statement of the project objectives and problems being addressed.
- The project partners and their roles, and the sources of funding.
- The approximate costs of implementing the project. (What were the main cost components? Were there any unforeseen costs?)
- The capital costs of vehicles, fuel infrastructure, and public works such as bus lanes and information systems. (Were they as anticipated?)
- The approximate running costs of the transport solution (Were they as anticipated? What was the fuel cost?)
- Any changes required to the transport system/infrastructure and the amount of co-operation required for project implementation. (Were services significantly interrupted when the project was implemented? Are there ways of ensuring early consensus between partners, e.g. ensuring minimal service disruption?)
- Results for as wide a range of impacts and indicators as possible.
- Information on the type and accuracy of models used in generating some of the indicators.
- Advice on vehicle testing procedures, models and methodologies used in the evaluation. (Were other methods considered? Why was the selected approach considered the most appropriate?)
- Feedback on the project design and what might have been done differently, with the benefit of hindsight.
- Identification of barriers to implementation, and successful methods for overcoming them.

Details of the project context are needed to support the transfer of findings to other cities.

- Details of local characteristics that might have a bearing on the interpretation of the local results and their transferability to other contexts.
- Learning about specific aspects of the demonstrated transport solution, such as changes in stakeholder expectations and user acceptance.

Although providing such information is unlikely to be the main priority for a local project, it is, however, vital for anyone attempting to achieve comparable results with a similar project in the future.

Because many aspects of a specific site are unlikely to be replicated elsewhere, it is important that other cities are made aware of which factors were "unique" to the site and which were general site characteristics. Information on the site selection criteria is useful in this context.

Reporting for dissemination

Since resources are always limited, it is not likely that a project will be able or willing to provide a complete general assessment to others, as the focus is on the project's own stakeholders. The site-specific evaluation may be tuned to local needs and contain confidential information, and therefore not be appropriate for wider distribution. Therefore it is suggested that a separate report for wider dissemination should be produced, with a dedicated section on transferability. This section should focus on:

- how site-specific factors may have influenced certain results;
- findings that can be generalised;
- recommendations for good practice elsewhere, including project management lessons and policy actions.

Involve stakeholders in interpreting the results for dissemination.

It is recommended that project partners with ambitions beyond the local level play a role in preparing this section. Such project partners may include representatives from higher policy levels, technology developers that operate on a larger market (or have ambitions to do so), and representatives from interest groups and city networks.

Ideally, all actors involved within projects would analyse and codify their results in this fashion, so that a general comparison of results may take place, and projects are able to be of assistance to one another. In the real world this is not likely to happen in a comprehensive fashion, but it is nevertheless good practice to reflect upon one's own project and record the findings (in accordance with standard practice for project management). An assessment of transferability may also help to identify possible pitfalls when attempting to scale up the scheme locally.

Communications strategy

Dissemination methods that have proved successful in spreading project awareness and results across Europe include:

- Web-sites (which have the advantage of being easily updated);
- the use of networks run by cities and lobby groups (such as alternative fuel groups and stakeholder associations);
- seminars and conference presentations;
- vehicle demonstrations;
- site visits by foreign experts and stakeholders;
- newsletters;
- local media: articles in local newspapers and interviews with local radio and TV channels.

Dissemination methods:

- Web;
- networks;
- presentations;
- vehicle demonstrations;
- site visits;
- newsletters;
- local media.

The benefits to the project of raising its external profile include:

- national and international prestige;
- greater access to the results volunteered by other projects;
- greater interest from suppliers;
- appreciation from national and European programme managers;
- building confidence among local and national politicians to promote alternative fuels.

Benefits of dissemination

The last of these benefits is significant. National and European programme managers need to evaluate the contribution of individual projects to the overall policy-related programme objectives. However, there is inevitably a time lag between project completion and its wider impacts, and a difficulty in showing an unambiguous cause-effect relationship between a small project and changes in the European transport system. What *can* be assessed is the progress made by each project along the "research impact pathway" – a concept developed by the EC SITPRO project. This pathway has four main stages: output of project results, dissemination of results, exploitation of results, and impact on policy goals. Therefore programme managers will be interested in the extent of dissemination (audiences, numbers reached) and evidence of exploitation by third parties achieved by each project.

National and European programme managers look for evidence of (a) effective dissemination and (b) exploitation by third parties.

What can be learnt on a European level from pilot and demonstration projects?

Demonstration projects have an important contribution to make at the European level, as they allow similar measures or applications to be designed, implemented and evaluated under rigorously controlled conditions, but within different social, legislative and financial frameworks. The differential nature of the results may well have important contributions to make to an assessment of barriers to implementation at the national or local level. For example, it is possible to examine and evaluate under which political, legislative, legal and financial frameworks a particular transport solution may have the most significant impacts.

Example: Quantifying the relative contributions of vehicle, systems and infrastructure developments

The measures implemented in the CENTAUR project are quantified as achieving over 250 tonnes-equivalent of petroleum (TEP) per site at the end of the first year of operation, with the savings set to rise to almost 800TEP per site per annum over a five-year planning period. Some 20% of the first year savings are attributed to vehicle innovation measures with systems measures providing the greatest savings initially. Over a longer time frame, the savings from infrastructure planning are the most important. CENTAUR has shown the importance of integrating different types of measures within single schemes.

	Annual Reduction CO2 Emissions				Annual Energy Savings			
	1ST year operation 1999		After 5 years (full benefit stream 2004)		1ST year operation 1999		After 5 years (full benefit stream 2004)	
	Tonnes	%	Tonnes	%	TEPs	%	TEPs	%
Vehicles and Fuels	720	15	720	5	491	19	491	7
Systems and Equipment	3592	74	5141	40	1793	72	2413	34
Infrastructure and Planning	533	11	7133	55	216	9	4267	59
TOTAL	**4845**	**100**	**12994**	**100**	**2500**	**100**	**7171**	**100**

Example: Barriers to wider take-up of the Bicycle Lift

The Bicycle Lift in Trondheim has successfully demonstrated the technical viability and user acceptance of electric-powered assistance for cyclists ascending steep hills in urban areas. Many other cities have taken an interest in this system, but no schemes have yet been taken forward.

The project manager has experienced that the lack of proof of transferable results is the main deterrent to market acceptance of the Bicycle Lift. Interviews with stakeholders have confirmed this hypothesis. One single prototype, even if it performs well and receives good publicity, is normally very hard to sell. Even the most clairvoyant champion in another city must show case study evidence and hard facts to sell the concept to local organisations and politicians.

This experience points to a critical benefit of multi-city projects and the co-ordinated evaluation of similar projects across a national or European programme.

Summary of good practice

Good practice

Recommended good practice in identifying the implications of project results for other cities is as follows:

- Produce transferable information by documenting the details of the project implementation and the city context as well as the actual results.
- Prepare a report that is explicitly targeted on wider dissemination, in consultation with stakeholders.
- Highlight the learning on issues of wider interest, such as barriers to new transport solutions, policy actions, user acceptance and stakeholder expectations.
- Disseminate the project findings widely using a variety of media.

Conclusions

The Guidelines provide a structured approach to thinking through the tasks and challenges in piloting the use of cleaner vehicles. Depending on the local situation, only parts of the Guidelines may be relevant, and the sequence of actions may be different.

Nevertheless, some common lessons may be drawn from the experience of previous projects:

- The definition of the project objectives should serve as a guiding vision for the project design and evaluation.
- Stakeholders and end-users should be drawn into the project from the start, whether as active partners or in a more consultative role.
- From the outset, the project concept should include a strategy or business plan for the transition from the pilot phase to further implementation.
- Where possible, projects should aim to simulate market conditions in order to learn how to optimise the transport solution for future applications. However, within the project, some protection from full market forces may be needed to permit this learning to take place.
- Learning should include such aspects as changes in stakeholder expectations, user needs and behavioural responses, barriers and policy changes. Such experiences are particularly important for transfer to other cities.
- Good practice in risk management should be observed, learning from the problems encountered in previous projects.
- The evaluation strategy should be developed from the outset, to ensure that results are targeted on showing unambiguously whether the project objectives have been attained.

Glossary

What is the meaning of some of the key words in these Guidelines?

The following list contains terms used in the Guidelines with definitions as they are used both here and generally in the transport sector in the context of pilot and demonstration projects.

active participants or partners individuals or groups who play a part in the conducting of a PROJECT, including all participants in the project who fulfil management, technical and/or evaluation roles.

actor an individual actively involved in the conducting of a PROJECT.

best practice or good practice processes, practices or systems identified in public and private organisations widely recognised as improving an organisation's performance and efficiency in specific areas.

bias the extent to which a MEASUREMENT or a sampling or analytic method systematically underestimates or overestimates a value, or the extent to which subjective factors influence project design and site selection.

consensus group agreement on the purpose and direction of a PROJECT, for instance between STAKEHOLDERS.

cost-benefit analysis (CBA) a monetary evaluation method where the costs and benefits of a PROJECT are expressed in monetary terms and presented in a balance sheet.

cost-effectiveness analysis (CEA) a monetary evaluation method in which not all of the benefits can be monetarised. This method provides a ranking of project options.

data groups of observations or measurements, either quantitative or qualitative, used as a basis for assessment.

decision criteria a set of factors used to examine and compare the costs, risks and benefits of projects and alternative actions.

decision points any of a number of points during the project lifecycle when decisions regarding future actions are made.

(detailed) design the STAGE of the PROJECT LIFECYCLE in which the full specification for the implementation of the PROJECT and TRANSPORT SOLUTION is developed.

European added value The extra benefits the European Union gains by funding PROJECTS in cities across Europe, rather than choosing single projects or leaving them to national authorities.

evaluation assessment of a PROJECT in terms of its objectives – whether they have been or will be achieved – and assessment of a demonstrated TRANSPORT SOLUTION in terms of its performance/ IMPACTS.

evaluation methods techniques for assessing the IMPACTS of a PROJECT or TRANSPORT SOLUTION.

evaluation plan or strategy a scheme devised during the early STAGES of a PROJECT to guide the evaluation process through the PROJECT LIFECYCLE.

ex-ante evaluation the assessment of the *estimated* IMPACTS of a PROJECT, with emphasis on what is likely to happen if the project is implemented and if it is not. It is made on the basis of the DETAILED DESIGN.

ex-post evaluation the assessment of the *actual*, measured IMPACTS of a PROJECT. It provides the basis for forecasting the probable IMPACTS of FULL-SCALE IMPLEMENTATION.

full-scale implementation the undertaking of a scaled-up version of a PROJECT. This option could be a logical next step following successful completion of a PROJECT.

functional specification detailed description of the construction and operation of a TRANSPORT SOLUTION to be implemented.

impacts effects of or changes brought about by the implementation of a PROJECT. *Expected impacts* are those considered likely on the basis of existing knowledge, research and expert opinion on the potential success of particular types of PROJECT; they are important in the initial evaluation phase. *Estimated impacts* are formulated by educated guesswork; they are important in the ex-ante evaluation phase. *Actual impacts* are measurable changes resulting from the implementation of a PROJECT; they are assessed during the ex-post evaluation phase. Impacts may also be *direct*, if they result directly from the IMPLEMENTATION of a PROJECT, or *indirect* (or *secondary*), if they occur as a consequence of direct impacts.

implementation of the project the STAGE of the PROJECT LIFECYCLE at which the scheme that has been designed is put into operation and data are collected on the performance and IMPACTS of the TRANSPORT SOLUTION.

indicators units of measurement of the PROJECT'S IMPACTS.

initial evaluation the first assessment of the expected IMPACTS of a PROJECT. It is made on the basis of the PRELIMINARY DESIGN.

learning the process of gaining new knowledge and understanding from a PROJECT. This includes learning about technical matters such as vehicle performance. However, learning about less tangible outcomes such as user behaviour and institutional changes are equally important. All pilot and demonstration PROJECTS offer opportunities for learning, whether or not the tested TRANSPORT SOLUTION is judged to be a success or a failure.

market transformation or stimulation government actions to work with lead suppliers and customers to achieve a critical threshold of supply and demand for new (vehicle and fuel) technologies, supported by policy actions to boost confidence in the sustainability of the market..

measurement a procedure for assigning a number to an observed object or event; also the act of measuring and the number itself.

measures actions designed to bring about a desired end. A group of similar measures may be classified as a 'strategy'. One important category concerns the POLICY MEASURES used to facilitate PROJECT IMPLEMENTATION.

model a simulation or representation of a process, system or subject area. In a transport PROJECT, a model is often used to estimate IMPACTS such as traffic flows, emissions and air quality.

monetary evaluation methods a group of evaluation methods for use when the IMPACTS of an alternative can largely be expressed in monetary terms.

multi-criteria analysis (MCA) a NON-MONETARY EVALUATION method providing a flexible way of dealing with qualitative and quantitative multidimensional IMPACTS of TRANSPORT SOLUTIONS and PROJECTS.

new propulsion systems a collective term for innovative propulsion technologies. The innovation may be a new fuel (e.g. natural gas), a new energy conversion system (e.g. battery, fuel cell), or a new drive train (e.g. hybrid diesel-electric).

non-monetary evaluation methods a group of evaluation methods for use when the majority of IMPACTS cannot be expressed in monetary terms.

non-technical policy measures actions that aim to change travel patterns and behaviour rather than the transport technologies. (Nevertheless, a non-technical measure may subsequently influence technology choices and may require technical equipment to be used in its implementation.) For example, vehicle emissions regulations are classed as technical measures, while a Low Emission Zone (excluding a vehicle from a city centre depending on its emissions characteristics) is a non-technical measure. In clean vehicle projects, non-technical measures such as preferential treatment of public transport are often used to increase the impact of the new vehicle technologies.

parameters characteristics that can be measured or quantified.

phase a period during the PROJECT LIFECYCLE when a specific process (such as DESIGN or EVALUATION) takes place.

pilot/demonstration project the innovative application and assessment under real life conditions of a TRANSPORT SOLUTION or SOLUTIONS.

policy principles for actions or MEASURES proposed or adopted by local, national or European governments.

policy goals general aims towards which policies are intended to contribute, such as environmental protection and social equity.

preliminary design the STAGE of the PROJECT LIFECYCLE when the functionality of the system to be implemented is specified, based on project objectives, user needs and site characteristics.

programme managers those who run large-scale programmes at national and European levels, aimed at sponsoring and co-ordinating the activities of individual PILOT AND DEMONSTRATION PROJECTS. Programme objectives will often influence the objectives, design, evaluation and dissemination of the PROJECTS.

project a finite initiative to test some hypotheses defined by the project objectives. In these Guidelines, a project is a PILOT OR DEMONSTRATION PROJECT with cleaner vehicles. The project starts when the PROJECT CHAMPION develops its objectives and conceptual design and seeks stakeholder support. The project ends when the technical implementation is complete, the results have been evaluated, and the implications for decision-making on any exploitation have been identified.

project champion the key individual(s) who takes the lead in initiating and promoting the PROJECT. The PROJECT CHAMPION may also become the PROJECT MANAGER, but this is not necessarily the case.

project lifecycle the time period from the inception of the project, beginning with the decision whether a PROJECT is appropriate and ending with the decision, after implementation of the PROJECT, to proceed or not to full-scale implementation of the project.

project managers those who need to know the steps to be taken in conducting the PROJECT. They have to ensure that these steps are taken, mobilise the resources, assure the quality of the project, assemble the results, and present the options and recommendations to the decision-maker(s). These individuals are likely to have a significant role in the preparation of objectives, the site selection process and in attempts to achieve consensus. They can use these Guidelines as a reference, to help them to guide, instruct and monitor the experts within the project team.

project partners organisations involved in directing and implementing the PROJECT. These may include, for example, the vehicle operator, the local authority and a technology developer.

qualitative to be expressed in words rather than numerical values; used of data pertaining, for example, to attitudes, opinions, perceptions and observations.

quality control and quality assurance design and review procedures to validate and document that the project is in keeping with specifications.

quantitative to be expressed as a numerical value; used of data pertaining, for example, to speed and time.

range a measure of spread in variables or outcomes.

reliability the quality of a measurement process that would produce similar results from (a) repeated observations of the same condition or event or (b) multiple observations of the same condition or event by different observers.

risk analysis, risk management RISK ANALYSIS is a technique to identify and assess factors that may jeopardise the success of a project or the achievement of an objective. It is the essential input to RISK MANAGEMENT, where the PROJECT MANAGERS define preventive measures to reduce the probability of these factors occurring and identify countermeasures to address these constraints should they develop.

risk the source of an unexpected or unwanted outcome, the likelihood of that outcome, and/or the potential for loss as a consequence of that outcome. For example, risks may be associated with (statistical) uncertainty in data, assumptions made at the design stage, and unforeseen external events.

selection parameters characteristic features of a site that should be present before it is considered for inclusion in a PROJECT.

site selection the STAGE of the PROJECT LIFECYCLE when potential sites are considered for inclusion in the PROJECT and decisions are made regarding the suitability of each for implementing the transport solution.

stage a period during the PROJECT LIFECYCLE when decisions are made and activities carried out in order to conduct a PROJECT.

stakeholders all those groups or individuals who are likely to be influenced by the results of the PROJECT. Some stakeholders may be actively engaged in directing and implementing the PROJECT as PARTNERS. Other stakeholders may have no direct involvement, although it is generally advisable that PROJECT MANAGERS initiate and maintain a dialogue with stakeholder representatives.

strategies plans for putting policies and objectives into action. Examples include POLICY STRATEGIES, which define co-ordinated MEASURES to address specific transport problems, and EVALUATION STRATEGIES, which define the methods and processes for evaluating PROJECTS.

structured interview an interview in which the questions to be asked, their sequence and the information to be gathered are all predetermined; used where maximum consistency across interviews and interviewees is needed.

transferability the property of a project's results that enables them to be generalised from one project and applied to another.

transport concept or solution a system designed to provide a transport service. For example, short term rental of self-service cars.

users the people who use the transport solution or technology under demonstration. These may include passengers, drivers and vehicle operators. A distinction can be drawn between "leading edge" users (who are willing to try innovative products and services) and "average" users.

References

Where can I find further information?

The following list identifies selected Web sites that may help project champions and managers in setting up and running pilot and demonstration projects with cleaner vehicles. The list cannot be comprehensive, and it does not imply any form of recommendation or approval.

Alternative transport fuel lobby groups

- European Natural Gas Vehicle Association
  www.engva.org
- International Association for Natural Gas Vehicles
  www.iangv.org
- World LPG Association
  www.worldlpg.com
- European Electric Road Vehicle Association
  www.avere.org

EU Member State programmes on vehicle demonstrations

- UK Powershift programme
  www.est-powershift.org.uk
- French programme on clean vehicles
  www.ademe.fr
- Swedish vehicle and fuel programmes
  www.kfb.se
- Dutch sustainable mobility programme
  www.novem.nl
- Italian cleaner transport initiatives
  www.minambiente.it

Information on EU projects with cleaner vehicles

- ELTIS (European Local Transport Information Service)
  www.eltis.org
- THERMIE targeted transport projects
  www.thermie-transport.org

World-wide experiences and links

- US Department of Energy Alternative Fuels Data Center
  www.afdc.nrel.gov
- US Environmental Protection Agency
  www.epa.gov/otaq/consumer/fuels/altfuels/altfuels.htm
- US Alternative Fuel Directory
  www.vwc.edu/library_tech/wwwpages/gnoe/avd.htm

Assistance for project selection, management and evaluation

- "Navigate UTOPIA" support tool
  http://utopia.jrc.it/
- MAESTRO Guidelines
  www.europrojects.ie/maestro
- International Organisation for Standardisation (ISO)
  www.iso.ch
- ExternE project on external costs
  http://ExternE.jrc.es/

Information on alternative fuels and cleaner vehicles

- International Energy Agency Automotive Fuels Information Service
  innas@wxs.nl
- Report of the Alternative Fuels Group of the UK Government's Cleaner Vehicles Task Force, available from
  www.autoindustry.co.uk/library/books_reports/books_7.html
- Reports to the Canadian Government Transportation Climate Change Table
  www.tc.gc.ca/envaffairs/english/climatechange/ttable/

Information on case studies in these Guidelines

- Praxitele short-term EV rental scheme
  www-rocq.inria.fr/praxitele/
- Martigny CityCar short-term EV rental scheme
  www.post.ch/d/postauto/main/neue_angebote_citycar.html
- Mendrisio EV fleet test
  www.infovel.ch
- ZEUS project on low emission vehicles
  www.zeus-europe.org
- CENTAUR project (including Bristol, Bologna and Dublin examples)
  btsa@teleline.es
- French CNG bus programme
  www.ademe.fr
- Skåne electric vehicle programme
  www.kfb.se/ehvproge/ (www.vinnova.se from late 2000)
- Trondheim bicycle lift
  http://spiderman.novit.no/dahls/Trampe/
- Le Touc EV service
  www.letouc.fr
- Linköping biogas bus project
  www.kfb.se, www.linjebuss.com, www.sbgf.org, www.sgc.se
- Leeds guided bus project
  www.eltis.org

Annex 1.
List of transport applications

What are the transport applications covered by these Guidelines?

This Annex provides a non-exhaustive list of transport applications to which the Guidelines might be applied.

Combinations of technologies and transport services

Possible and promising combinations

Transport solutions involving cleaner vehicles may be considered as combining the following elements:

- a propulsion system;
- a fuel;
- a vehicle concept;
- a transport concept;
- a pattern of trips.

The more credible options for each of these elements are listed in the following sections (for *urban road applications* only, although the Guidelines are also relevant for non-urban applications). Not all combinations are feasible, and even fewer combinations are seen as holding much potential. Therefore this Annex concludes with a (non-exhaustive) list of promising combinations that are attracting interest for pilot and demonstration projects.

The Guidelines have been primarily motivated by projects involving alternative fuels, such as electricity, natural gas and liquefied petroleum gas. Nevertheless, they are equally relevant to projects focused on advanced conventional fuels, such as diesel buses. The Guidelines consider the simpler cases of technology substitution, as well as more challenging attempts to introduce new transport concepts such as short-term public rental schemes.

Propulsion system options

- human power
  - power-assisted bicycle (electric or ICE; cable-driven bicycle lift)
- Otto (typically gasoline) spark ignition engine
  - conventional
  - direct injection
  - two-stroke conventional
- Diesel (typically diesel fuel) compression ignition engine
  - conventional
  - advanced direct injection
  - modified (for alternative fuels e.g. alcohol, DME)
- electric propulsion
  - battery: rechargeable (e.g. lead-acid) or primary (e.g. zinc-air)
  - overhead or underground supply
  - fuel cell
  - energy storage (e.g. supercapacitor, flywheel)
- hybrid propulsion
  - series and parallel designs
  - ICE or fuel cell.

Fuel options

- advanced gasoline
- advanced diesel
- alcohols (ethanol or methanol, e.g. from biomass)
- LPG
- CNG, LNG
- bio-gas
- hydrogen
- electricity (from conventional or renewable sources)
- FAME/FAEE (diesel substitute, commonly termed biodiesel)
- DME (diesel substitute)
- blends of gasoline (e.g. with alcohols)
- blends of diesel (e.g. with FAME).

Vehicle concepts

- bicycle
- moped/scooter
- lightweight cabin vehicle
- motorbike
- urban car
- man-wide car
- all-purpose car or conventional passenger car (including car-based vans and taxis)
- passenger van (mini bus)
- urban bus (small and standard, up to 10m)
- articulated bus (large, more than 10m)
- freight van
- small truck
- articulated truck.

Transport concepts

Passenger transport

- individual
- taxi
- demand-responsive (e.g. flexible bus service)
- ride-sharing (e.g. private car pooling)
- rent-a-vehicle (e.g. car sharing, car rental, public city bikes)
- collective (e.g. bus)
- integrated/combined (e.g. park and ride, bike and ride, bicycle lift).

Freight transport

- individual linkage
- collective linkage (e.g. freight transhipment)
- collection/distribution (e.g. shop to customer delivery, garbage collection).

Trip patterns

- inner urban area traffic
- suburb–centre and extra-urban–centre linkage
- residential area collection and distribution
- linkage between locations on the urban periphery
- inner city shop supply
- shop/warehouse to customer delivery.

Promising combinations

Inner urban area passenger traffic

- all-purpose car, individual transport, advanced gasoline and diesel
- all-purpose car, taxi, advanced gasoline and diesel, electric, CNG, LPG and fuel cell
- urban car, individual transport, advanced gasoline and diesel, electric
- urban car, car rental, advanced gasoline and diesel, electric, hybrid and fuel cell
- bus, advanced diesel, hybrid, electric, CNG, LPG and fuel cell
- rent-a-bike/city bike, electric.

Extra-urban and suburban passenger linkage to centre (i.e. radial trips)

- all-purpose car, individual transport, advanced gasoline and diesel
- all-purpose car, car rental (e.g. car sharing club), advanced gasoline and diesel, CNG, LPG, electric battery, hybrid and fuel cell
- bus, collective and integrated (park and ride, bike and ride), advanced diesel, hybrid, CNG, LPG and fuel cell.

Inner urban area goods and services

- van, advanced diesel, LPG, CNG, hybrid, electric and fuel cell
- municipal service vehicle, advanced diesel, electric, LPG, CNG, hybrid and fuel cell.

Extra-urban goods and services linkage to centre (i.e. radial trips)

- van and small truck, individual delivery, advanced diesel, LPG, CNG, hybrid and fuel cell
- articulated truck, individual delivery, advanced diesel, LPG, CNG, LNG and fuel cell.

Customer deliveries, involving:

- van and small truck, advanced diesel, electric, LPG, CNG, hybrid and fuel cell.

Linkage between locations on the urban periphery

- small bus, demand responsive, advanced diesel, hybrid, CNG, LPG and fuel cell
- all-purpose car, demand-responsive taxi, advanced diesel, CNG, LPG and fuel cell.